Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.

Supporting Informations

Designing versatile heterogeneous catalysts based on Ag and Au nanoparticles decorated on chitosan functionalized graphene oxide

Rajendiran Rajesh[a], E. Sujanthi,[a] S. Senthil Kumar[b*] and Rengarajan Venkatesan[a*]

a Department of Chemistry, Pondicherry University, Puducherry-605014, India.
Corresponding authors: Fax; +91-413-2655987; Tel:+91-413-2654415;
E-mail: venkatesanr.che@pondiuni.edu.in (R.Venkatesan)

b Environmental & Analytical Chemistry Division, School of Advanced Sciences, VIT University, Vellore-632014, India.
E-Mail: senthilanalytical@gmail.com

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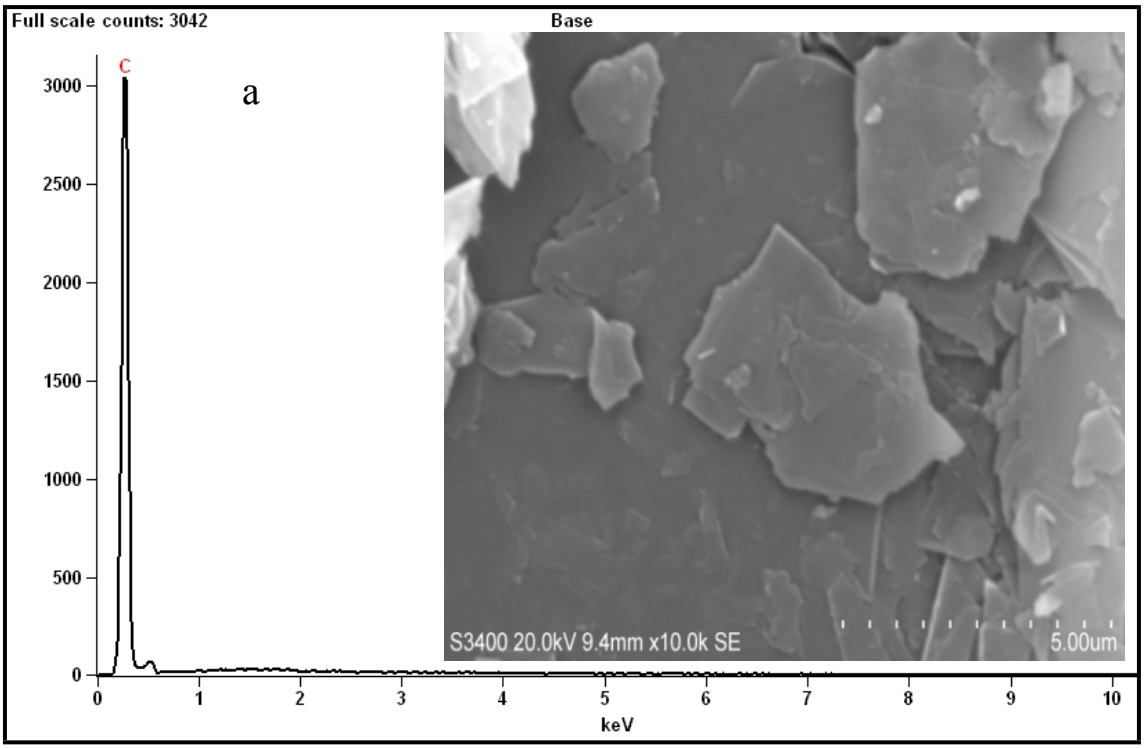
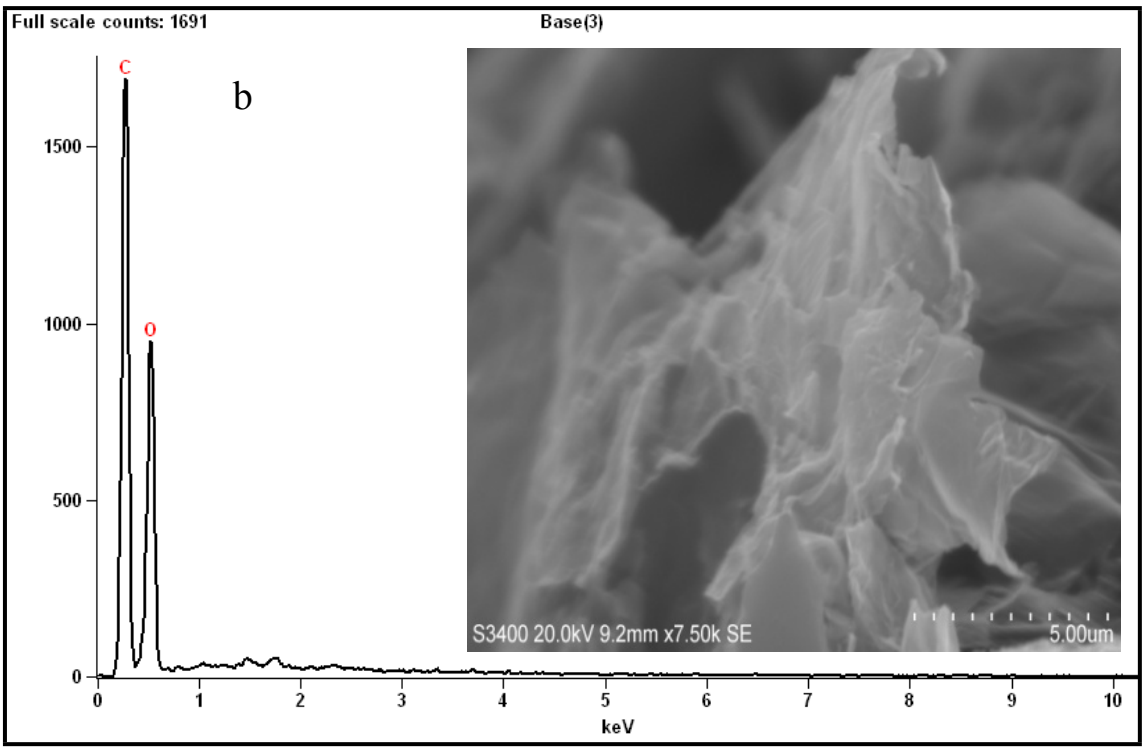
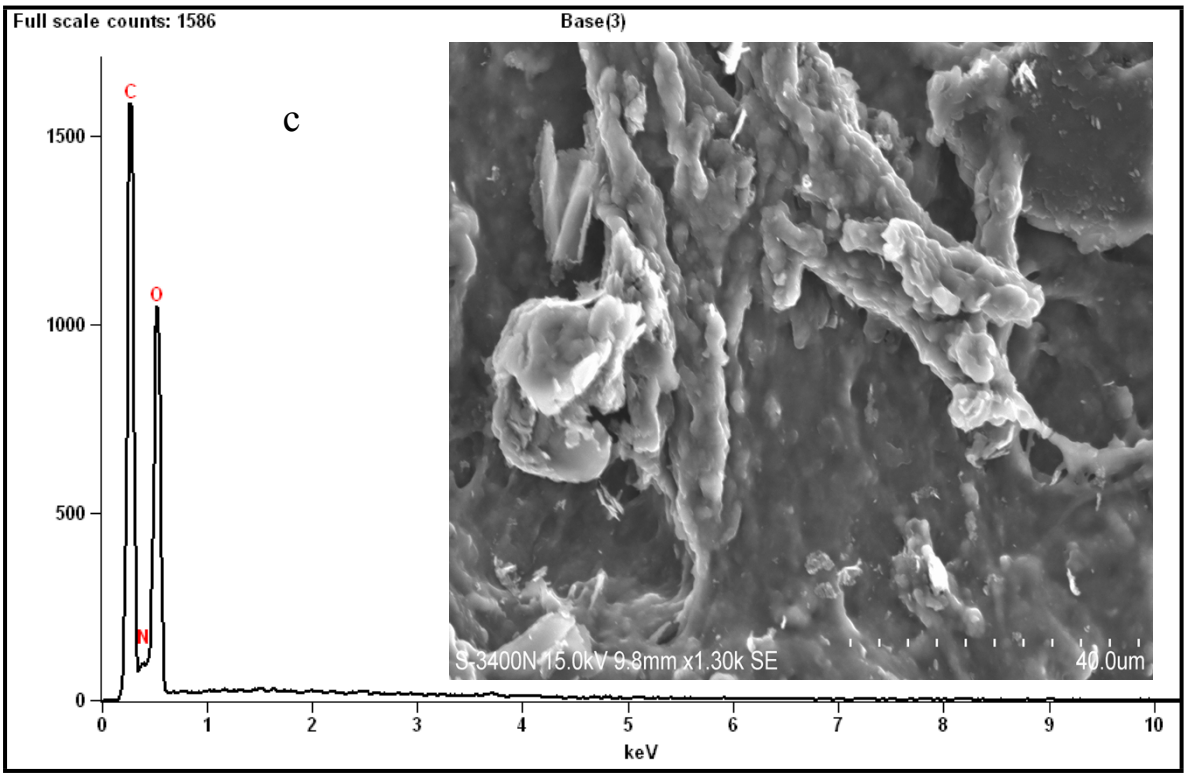
SEM and EDX analysis



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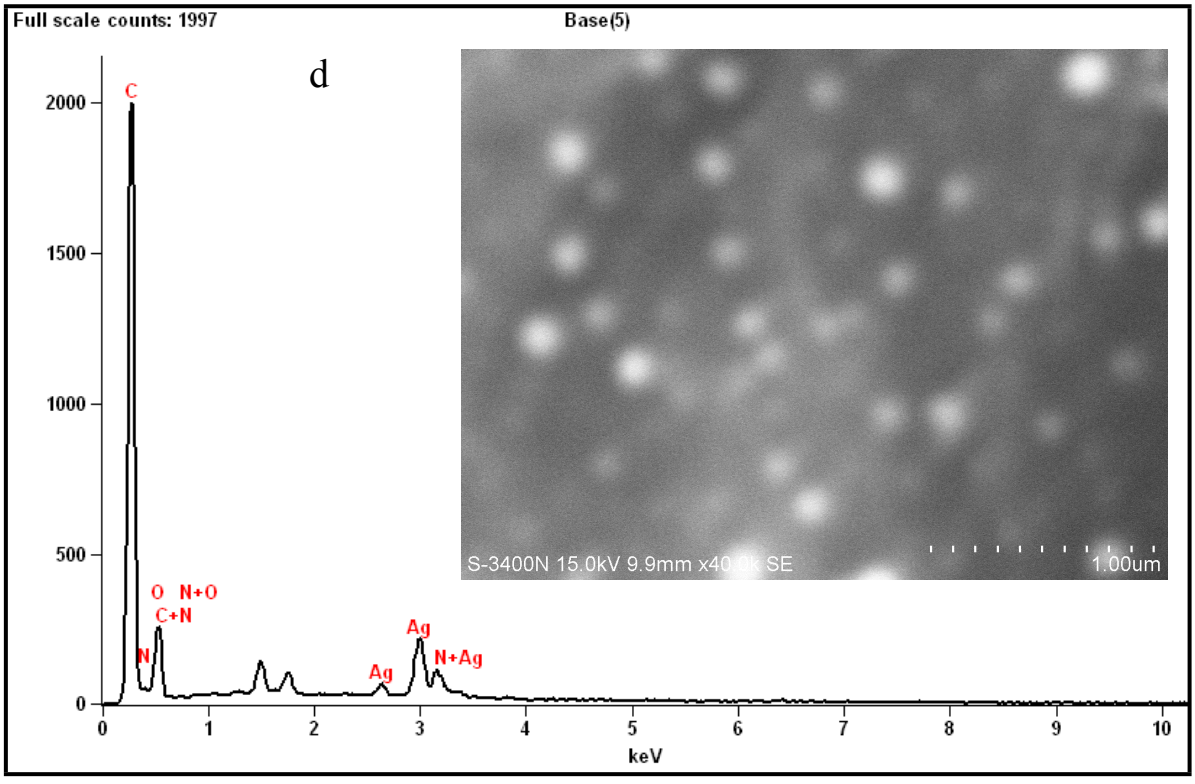
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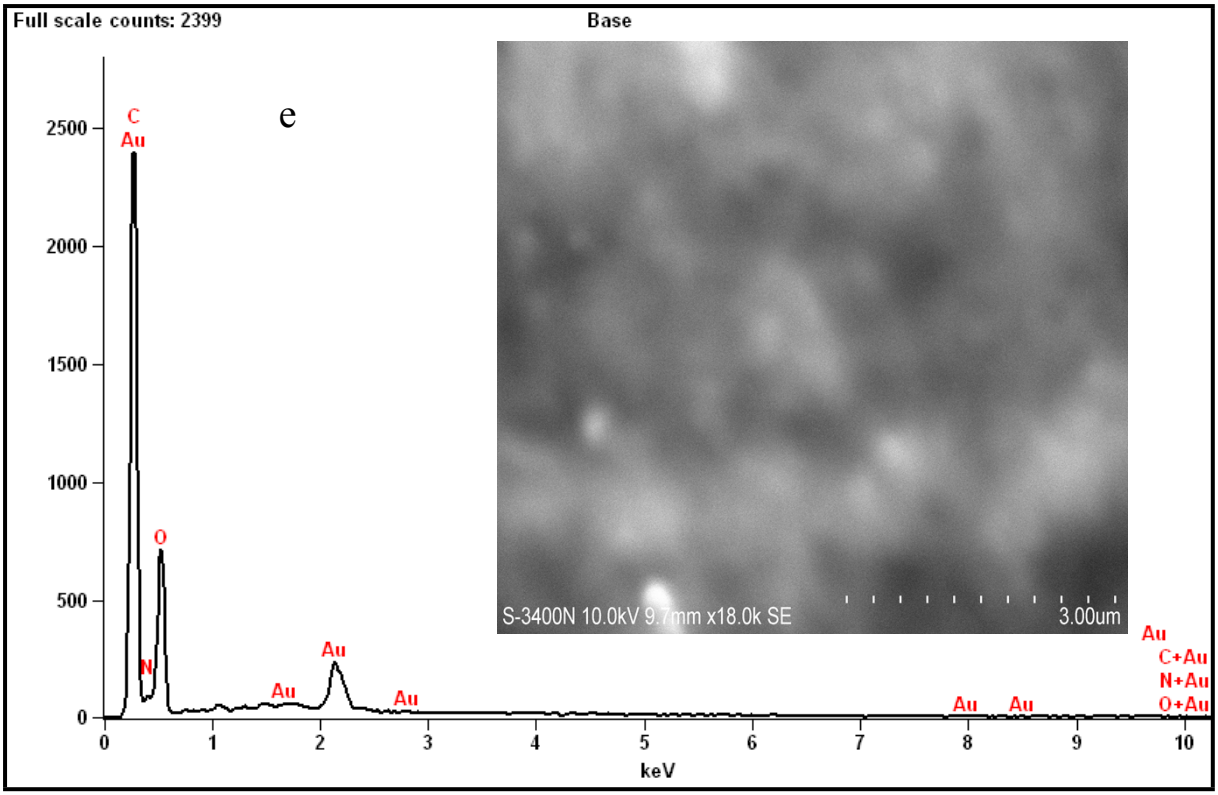

Fig. S1 SEM and EDX images of (a) pure graphite, (b) GO, (c) GO-Chit, (d) GO-Chit-AgNPs, (e) GO-Chit-AuNPs.

TEM analysis

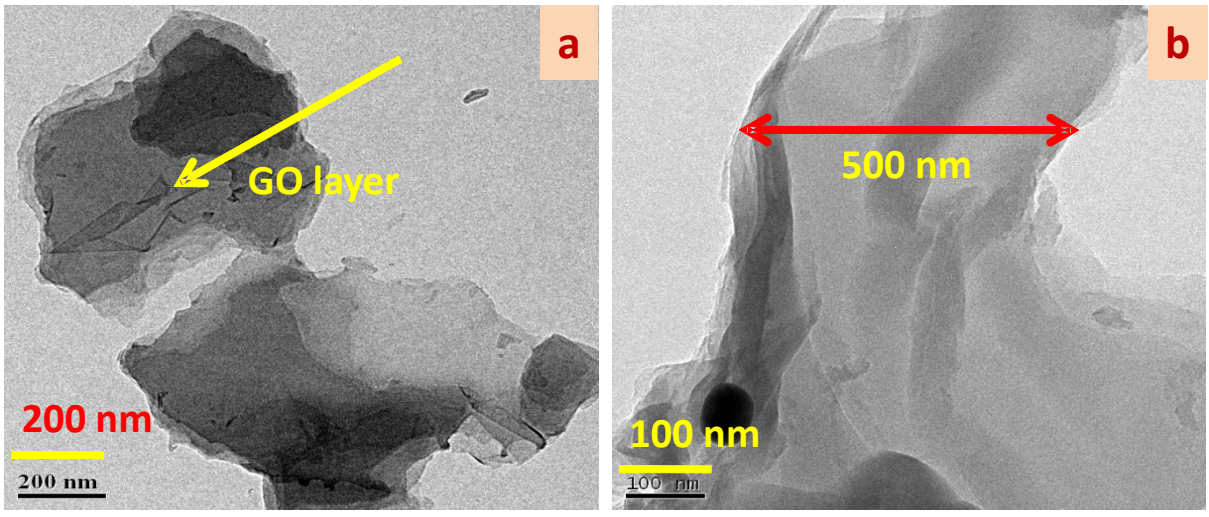

Fig. S2 TEM images of (a, b) GO layer.

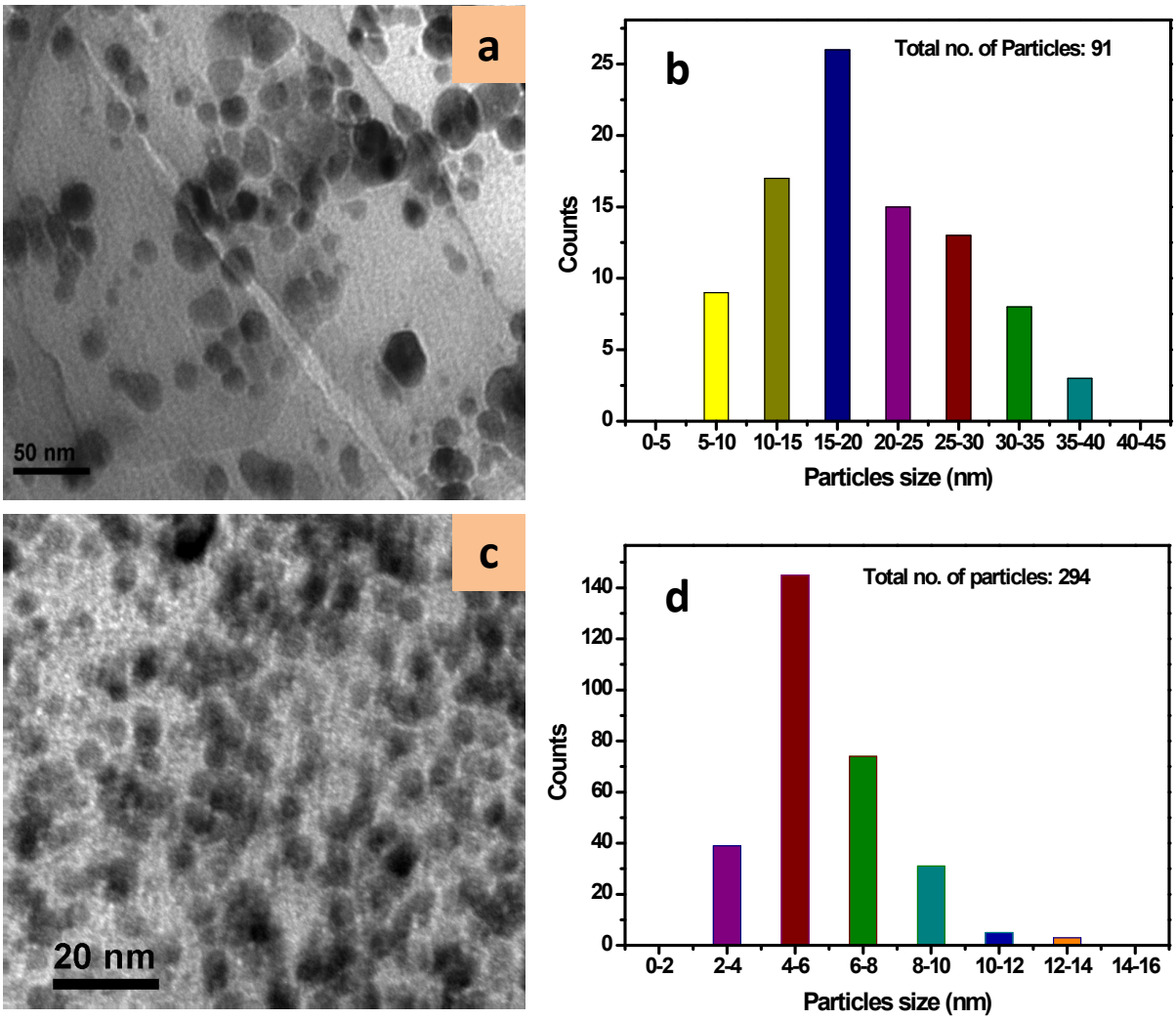

Fig. S3 TEM images and size histograms. (a, b) HR-TEM images of the GO grafted chitosan stabilized Ag NPs and their respective particles distribution histograms respectively. (c, d) HR-TEM images of GO grafted Au NPs and their respective particles distribution histograms respectively.

Effect of catalytic dosage

The effect of amount of catalyst on the rate of the reaction was determined by varying the catalytic dosage with respect to the identical concentration of $NaBH_4$, *p*-nitrophenol and azo dyes.

In order to examine the effect of catalytic dosage on the rate of the reduction of *p*-nitrophenol and azo dyes, the reaction was carried out in varying amount of Ag/Au NPs/GO-Chitosan by 1 mg increment, in presence of identical concentration of $NaBH_4$, *p*-nitrophenol and azo dyes. It can be observed from Fig. S4 to S6, that the rate of reaction increases with the amount of catalyst added upto 5 mg, and further increase in the amount of catalyst did not contribute for any significant enhancement in the reduction and degradation rate. Hence, 5 mg of the nanocatalysts has been chosen as the optimum dosage for efficient catalytic reduction of *p*-nitrophenol and azo dyes degradations.

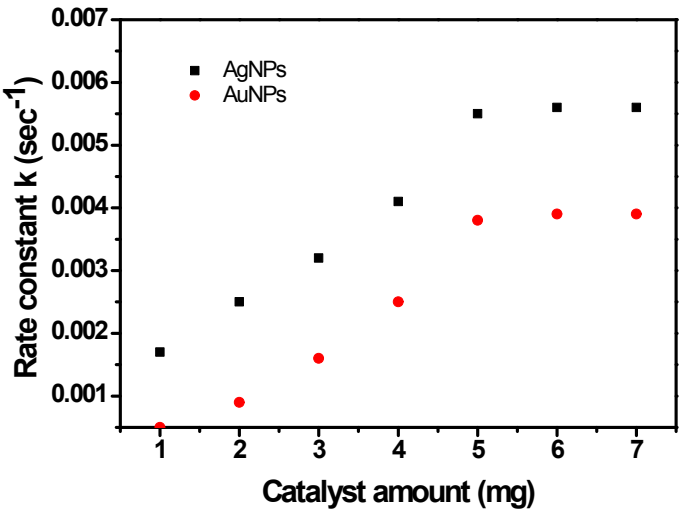

Fig. S4. Catalytic dosage for reduction of *p*-nitrophenol in presence of $NaBH_4$ was carried out at room temperature using different amount of Ag/AuNPs-GO-Chitosan.

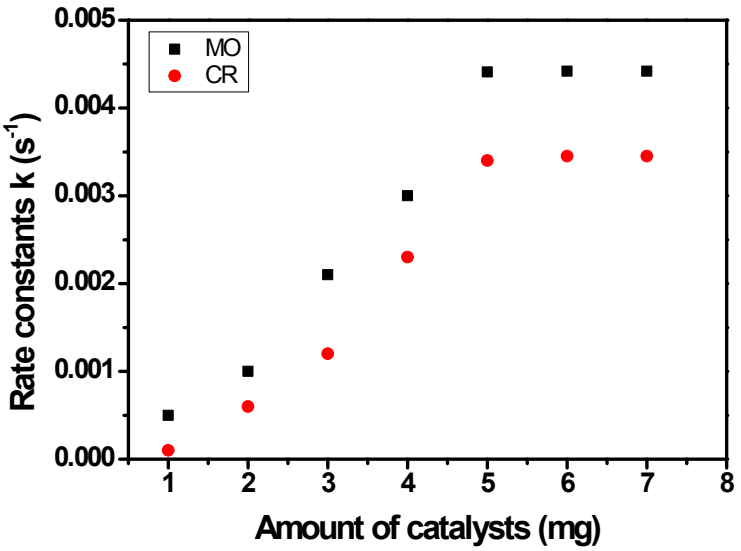

Fig. S5. Catalytic dosage for degradation of Methyl orange and Congo red was carried out at room temperature using different amount of AgNPs-GO-Chitosan.

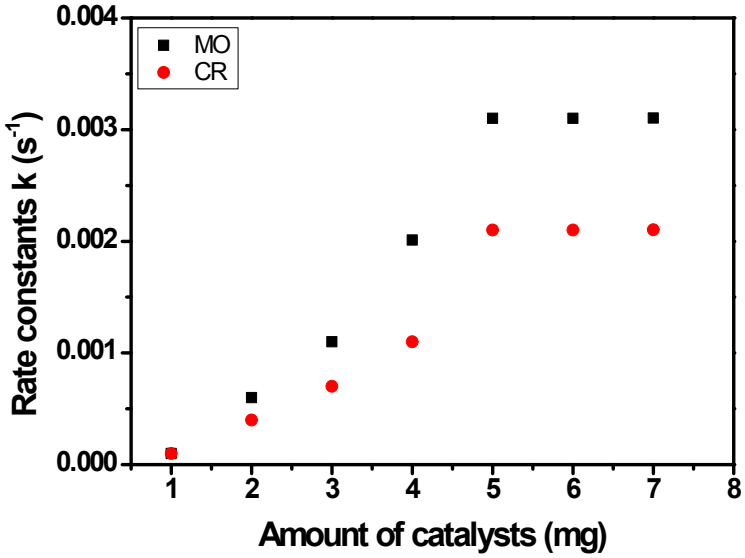

Fig. S6. Catalytic dosage for degradation of Methyl orange and Congo red was carried out at room temperature using different amount of AuNPs-GO-Chitosan.

The detailed kinetics spectrum of dyes degradation and nitro reductions are given below.

Catalytic dosage of AgNPs/GO-Chitosan in degradation of Methyl orange

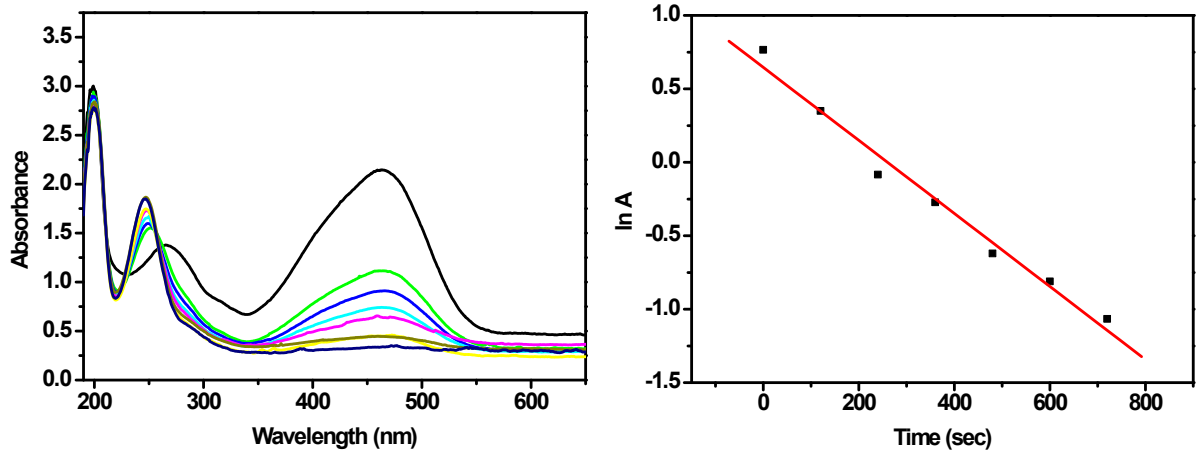

Fig. S7. UV-Visible kinetics spectrum for the degradation of methyl orange using 4 mg (AgNPs/GO-Chitosan). The obtained rate constant is (k) 3.01 x 10^{-3} s^{-1}

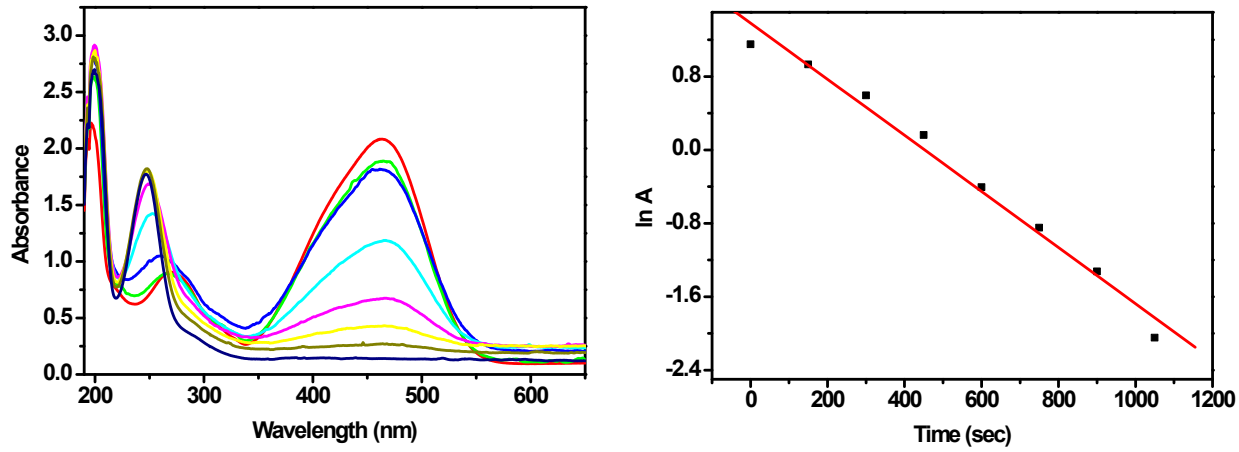

Fig. S8. UV-Visible kinetics spectrum for the degradation of methyl orange using 3 mg (AgNPs/GO-Chitosan). The obtained rate constant is (k) 2.001 x 10^{-3} s^{-1}

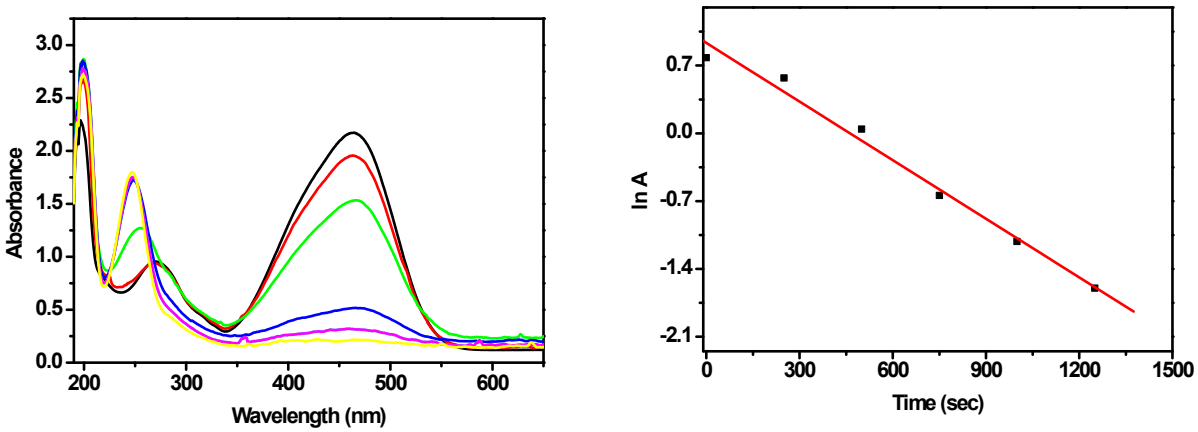

Fig. S9. UV-Visible kinetics spectrum for the degradation of methyl orange using 2 mg (AgNPs/GO-Chitosan). The obtained rate constant is (k) 1.02 x 10^{-3} s^{-1}

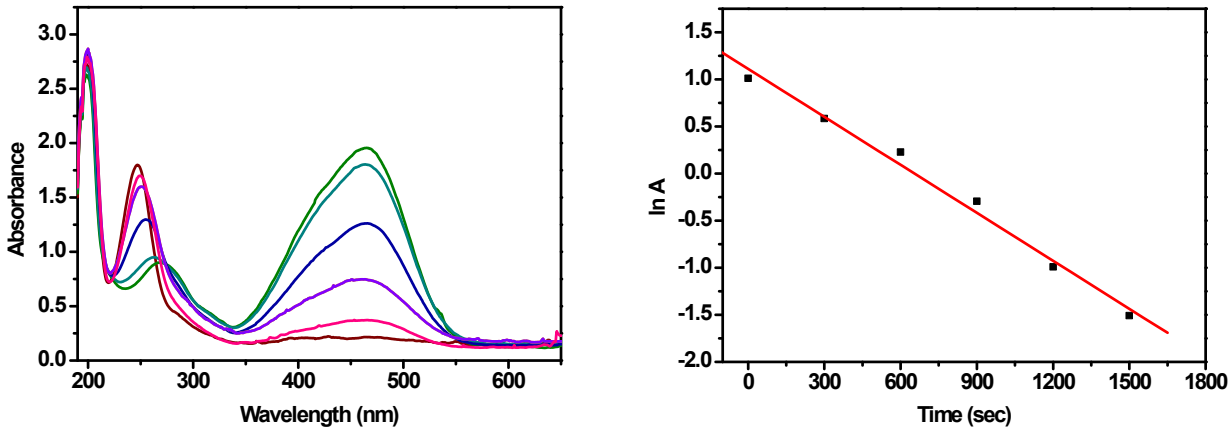

Fig. S10. UV-Visible kinetics spectrum for the degradation of methyl orange using 1 mg (AgNPs/GO-Chitosan). The obtained rate constant is (k) 0.51 x 10^{-3} s^{-1}

Catalytic dosage of AuNPs/GO-Chitosan in degradation of Methyl orange

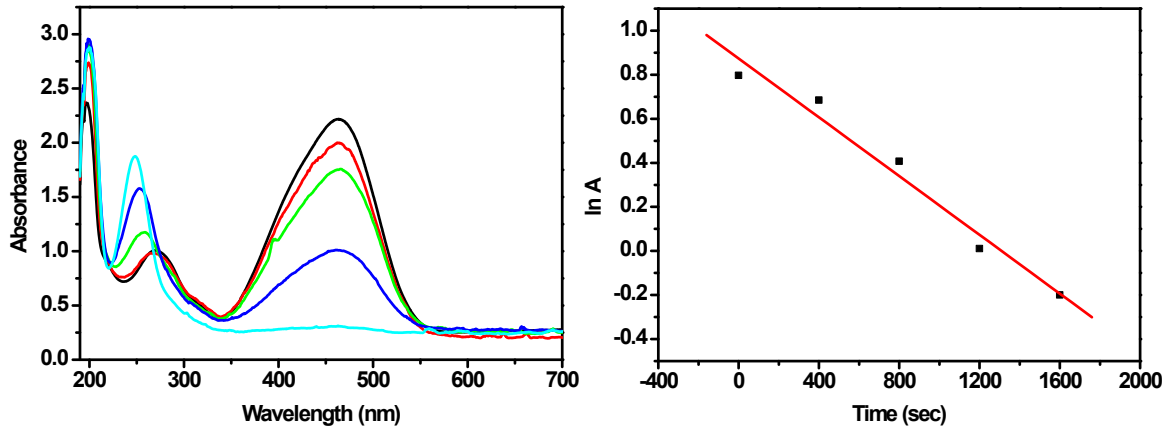

Fig. S11. UV-Visible kinetics spectrum for the degradation of methyl orange using 4 mg (AuNPs/GO-Chitosan). The obtained rate constant is (k) 2.01 x 10^{-3} s^{-1}

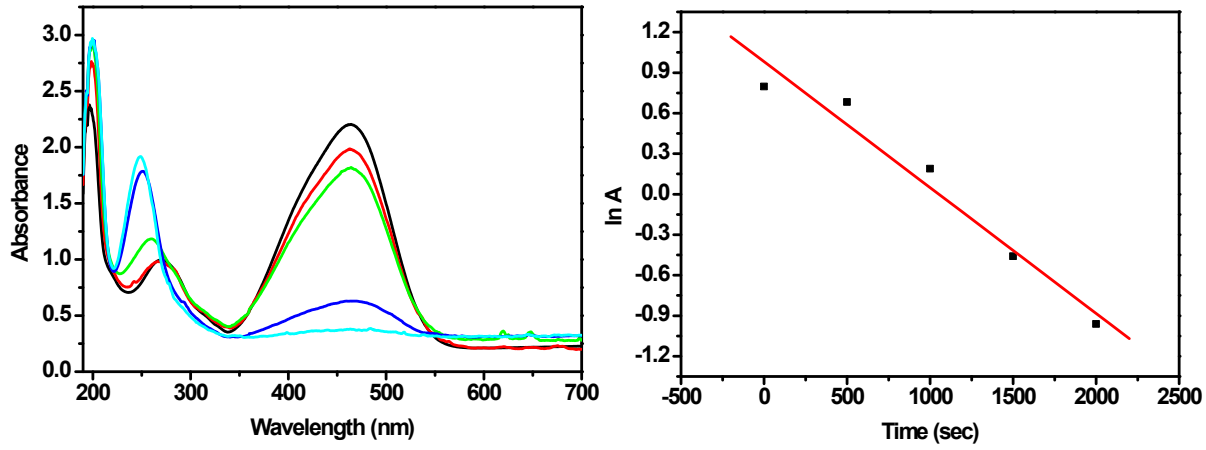

Fig. S12. UV-Visible kinetics spectrum for the degradation of methyl orange using 3 mg (AuNPs/GO-Chitosan). The obtained rate constant is (k) 1.1 x 10^{-3} s^{-1}

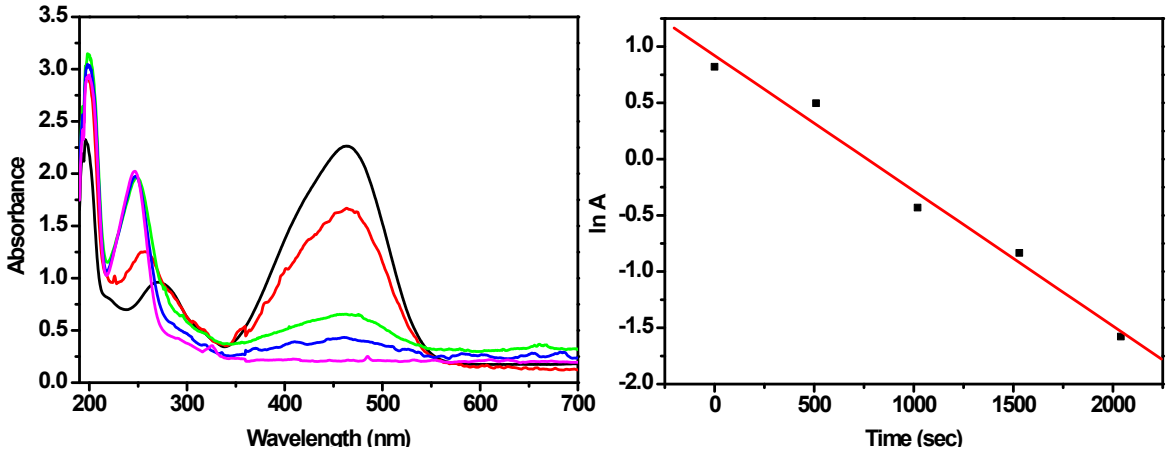

Fig. S13. UV-Visible kinetics spectrum for the degradation of methyl orange using 2 mg (AuNPs/GO-Chitosan). The obtained rate constant is (k) 0.6 x 10^{-3} s^{-1}

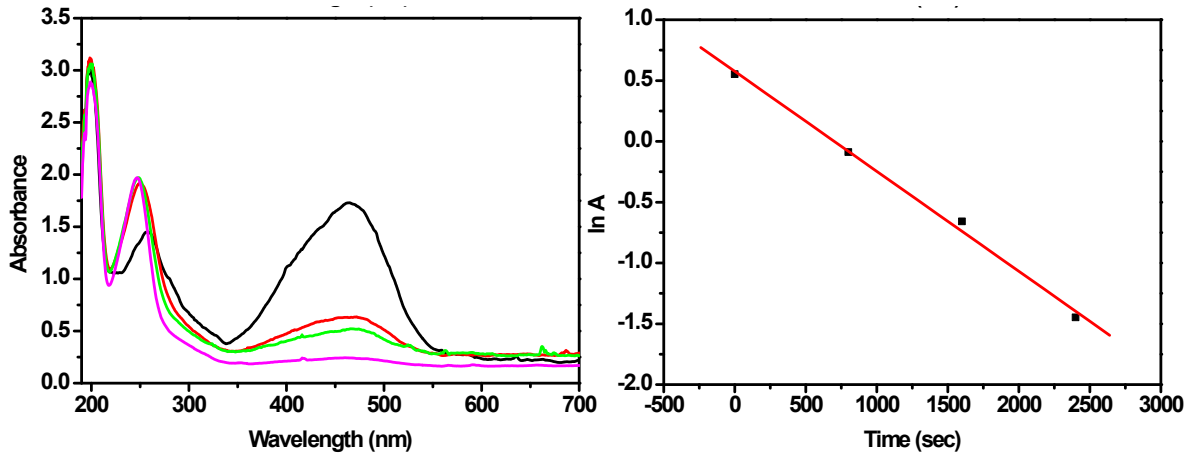

Fig. S14. UV-Visible kinetics spectrum for the degradation of methyl orange using 1 mg (AuNPs/GO-Chitosan). The obtained rate constant is (k) 0. 1 x 10^{-3} s^{-1}

Catalytic dosage of AgNPs/GO-Chitosan in degradation of Congo red

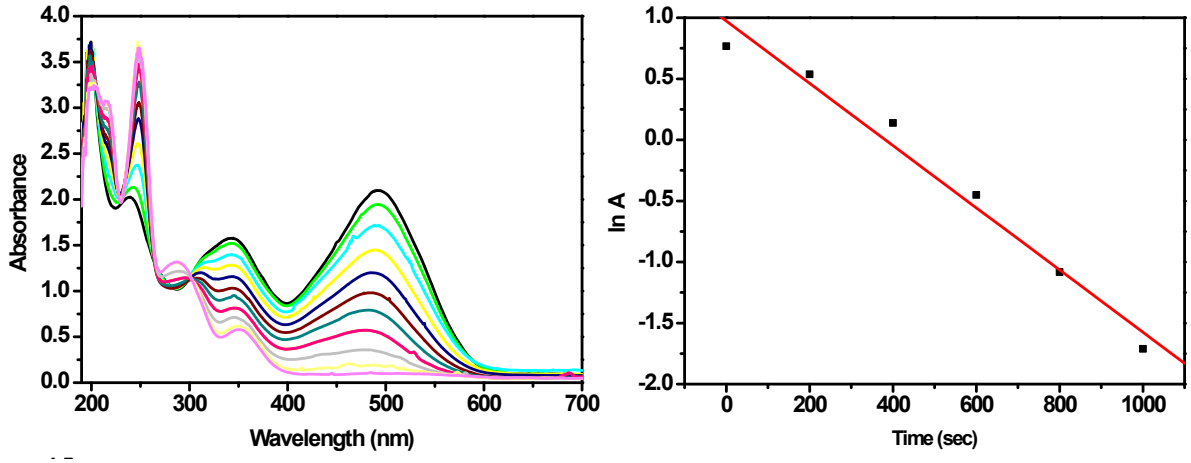

Fig. S15. UV-Visible kinetics spectrum for the degradation of congo red using 4 mg (AgNPs/GO-Chitosan). The obtained rate constant is (k) 2.41 x 10^{-3} s^{-1}

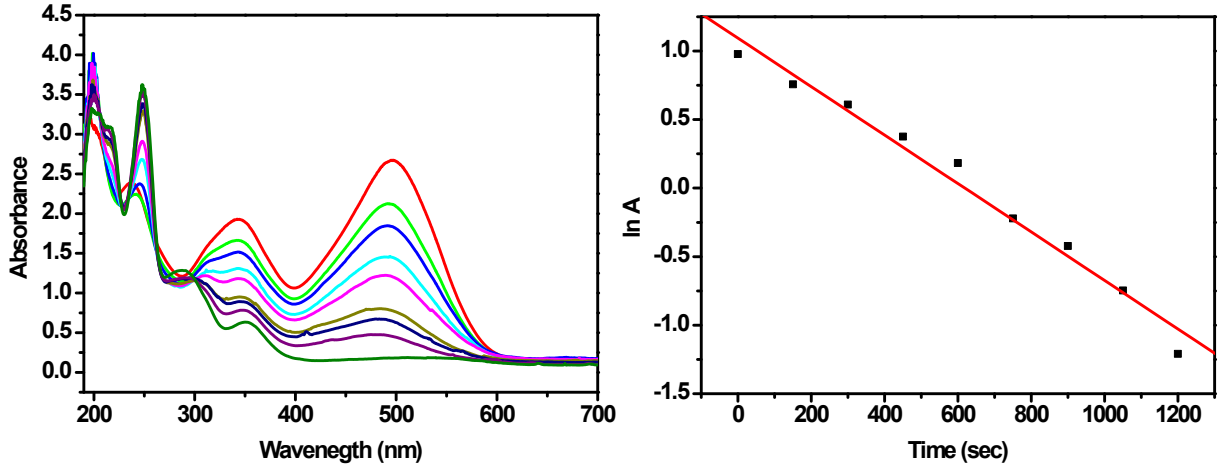

Fig. S16. UV-Visible kinetics spectrum for the degradation of congo red using 3 mg (AgNPs/GO-Chitosan). The obtained rate constant is (k) 1.27 x 10^{-3} s^{-1}

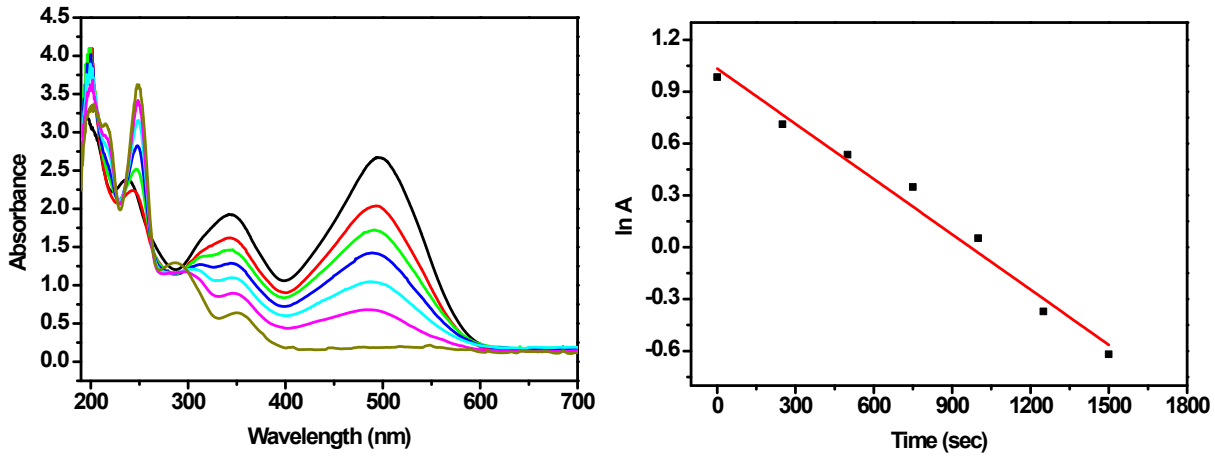

Fig. S17. UV-Visible kinetics spectrum for the degradation of congo red using 2 mg (AgNPs/GO-Chitosan). The obtained rate constant is (k) 0.7 x 10^{-3} s^{-1}

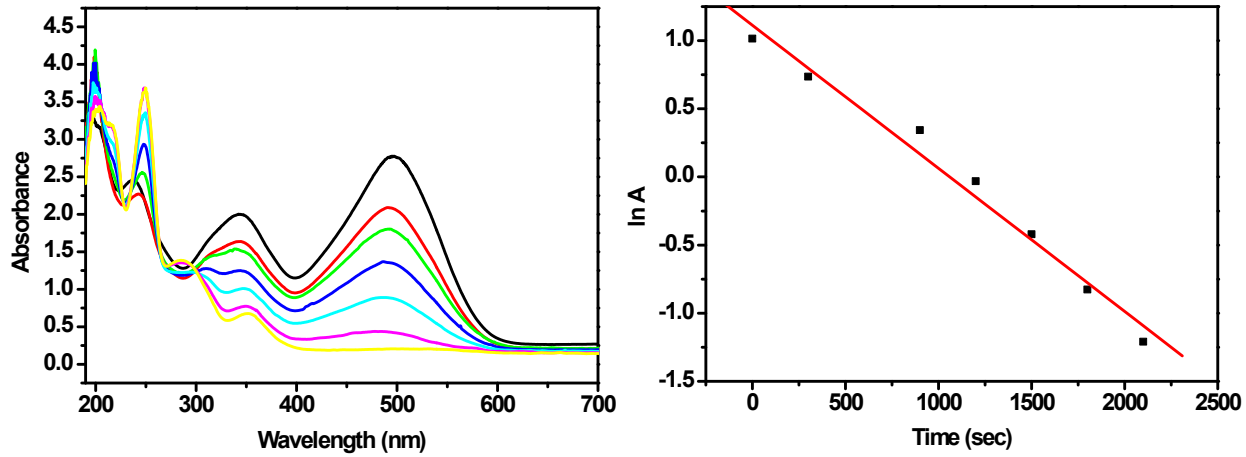

Fig. S18. UV-Visible kinetics spectrum for the degradation of congo red using 1 mg (AgNPs/GO-Chitosan). The obtained rate constant is (k) 0.1 x 10^{-3} s^{-1}

Catalytic dosage of AuNPs/GO-Chitosan in degradation of Congo red

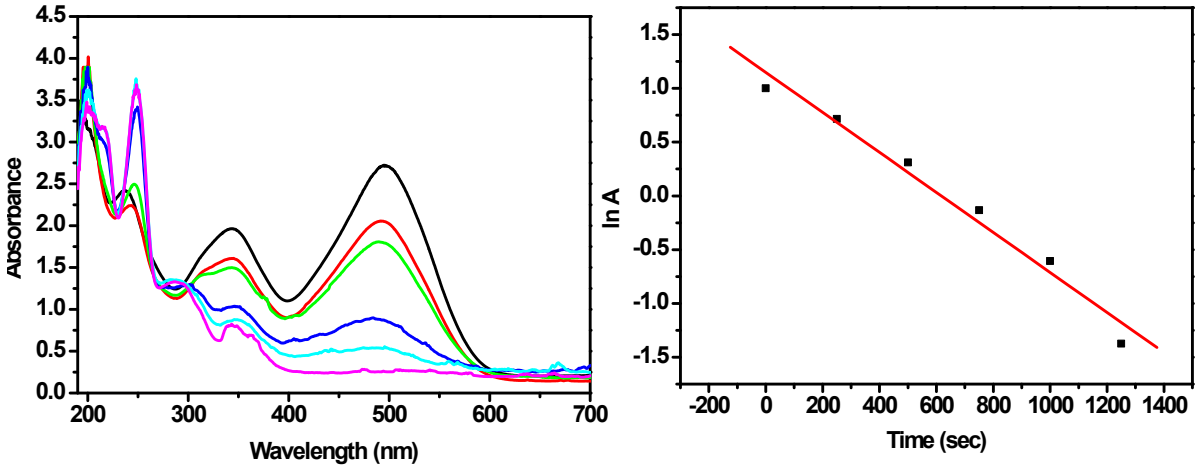

Fig. S19. UV-Visible kinetics spectrum for the degradation of congo red using 4 mg (AuNPs/GO-Chitosan). The obtained rate constant is (k) 1.1 x 10^{-3} s^{-1}

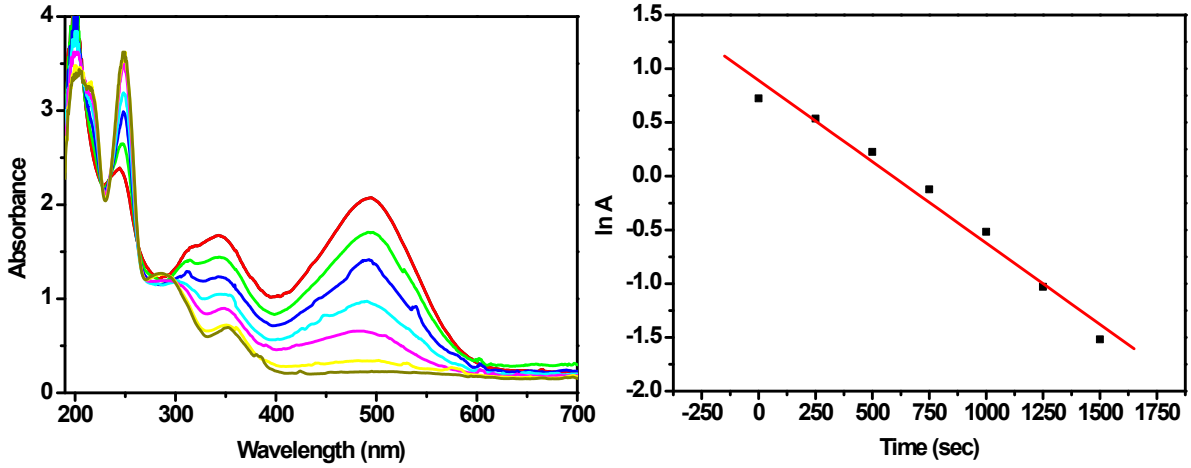

Fig. S20. UV-Visible kinetics spectrum for the degradation of congo red using 3 mg (AuNPs/GO-Chitosan). The obtained rate constant is (k) 0.7 x 10^{-3} s^{-1}

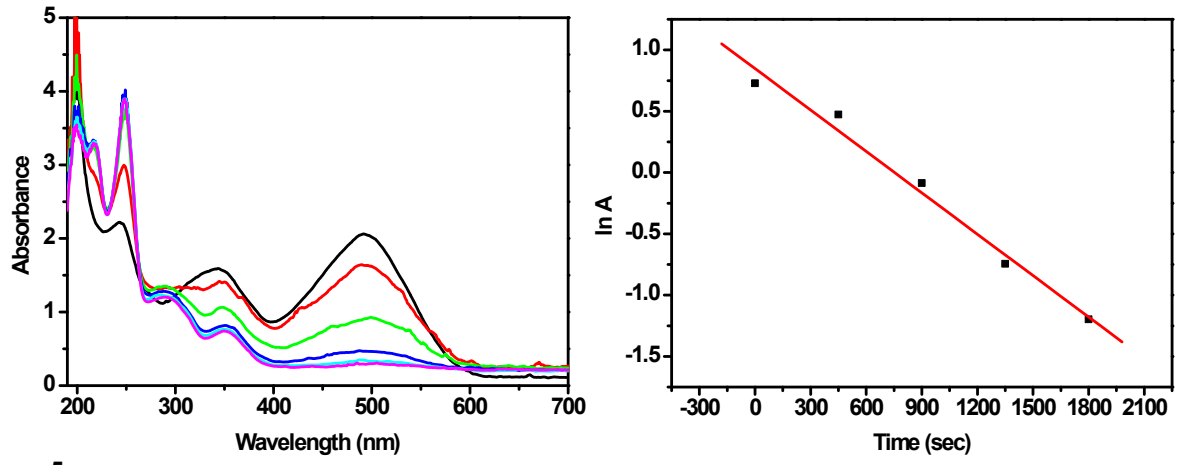

Fig. S21. UV-Visible kinetics spectrum for the degradation of congo red using 2 mg (AuNPs/GO-Chitosan). The obtained rate constant is (k) 0.4 x 10^{-3} s^{-1}

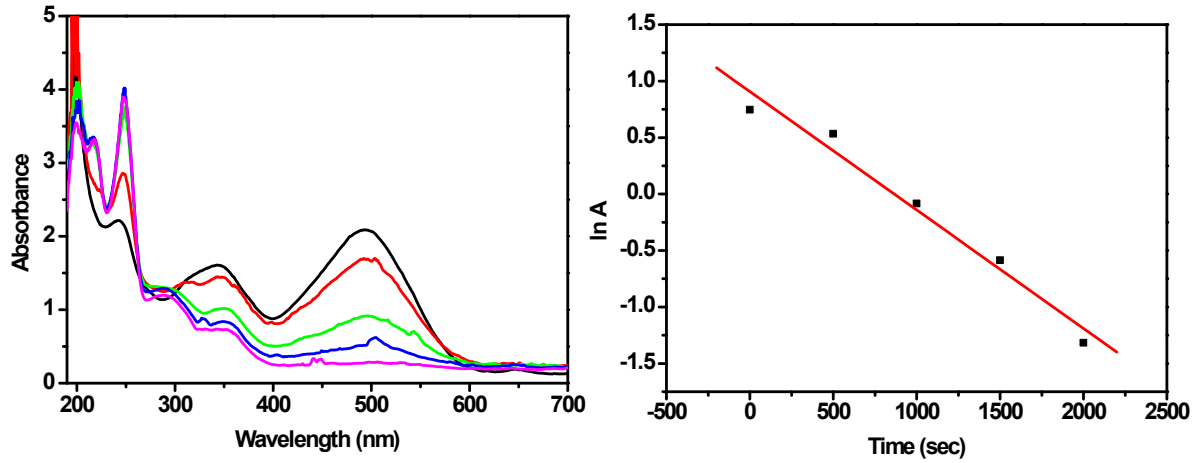

Fig. S22. UV-Visible kinetics spectrum for the degradation of congo red using 1 mg (AuNPs/GO-Chitosan). The obtained rate constant is (k) 0.1 x 10^{-3} s^{-1}

Catalytic dosage of AgNPs/GO-Chitosan in Reduction of p-nitrophenol

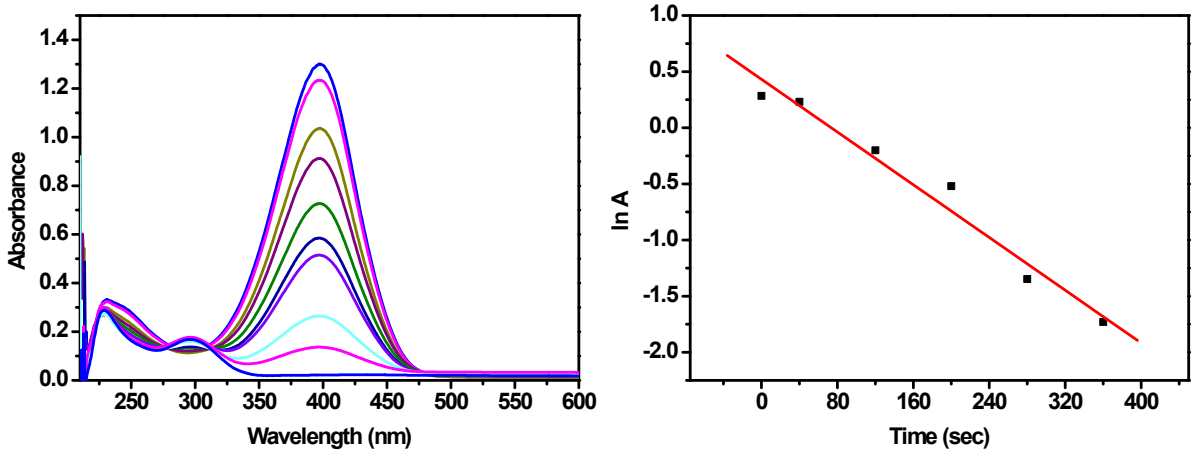

Fig. S23. UV-Visible kinetics spectrum for the reduction of p-nitrophenol using 4 mg (AgNPs/GO-Chitosan). The obtained rate constant is (k) 4.5 x 10^{-3} s^{-1}

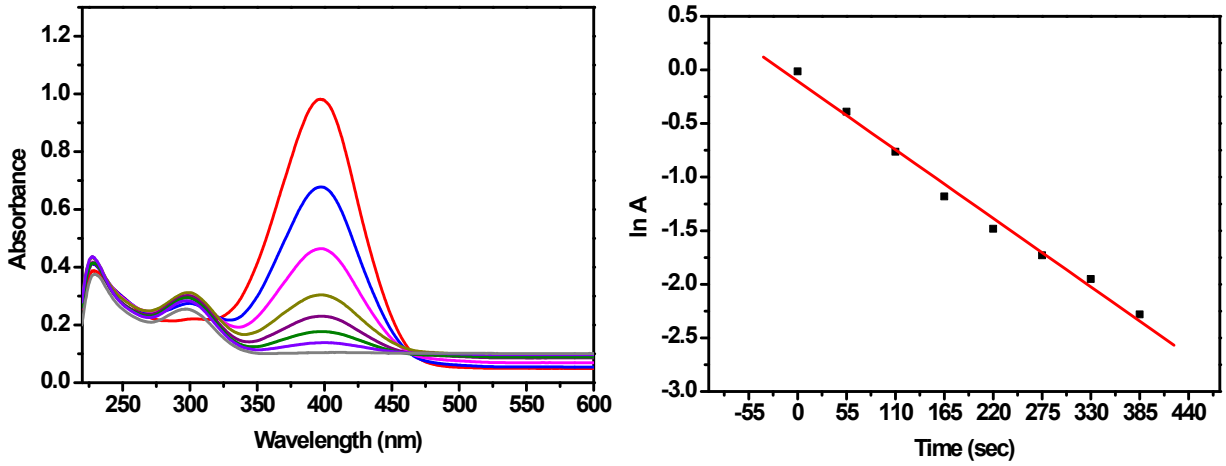

Fig. S24. UV-Visible kinetics spectrum for the reduction of p-nitrophenol using 3 mg (AgNPs/GO-Chitosan). The obtained rate constant is (k) 3.401 x 10^{-3} s^{-1}

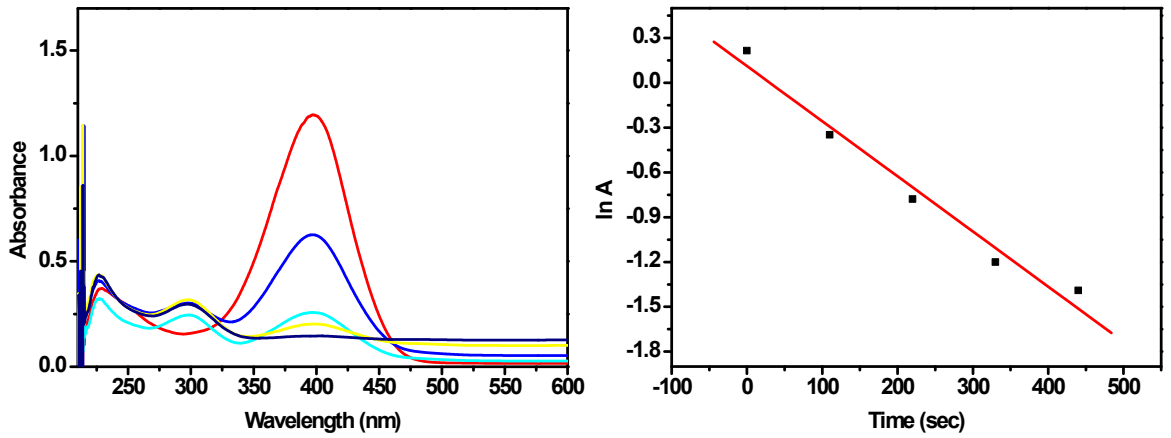

Fig. S25. UV-Visible kinetics spectrum for the reduction of p-nitrophenol using 2 mg (AgNPs/GO-Chitosan). The obtained rate constant is (k) 2.01 x 10^{-3} s^{-1}

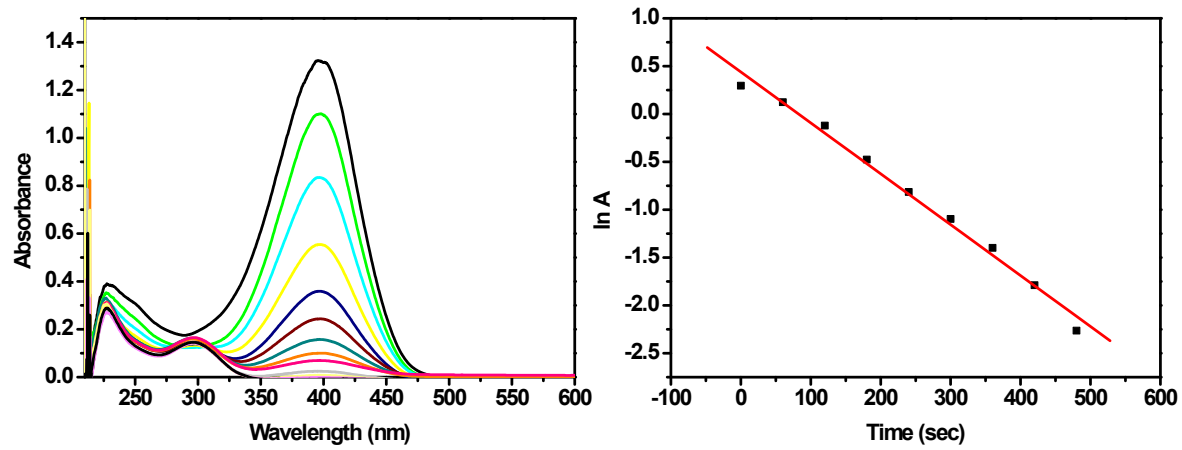

Fig. S26. UV-Visible kinetics spectrum for the reduction of p-nitrophenol using 1 mg (AgNPs/GO-Chitosan). The obtained rate constant is (k) 1.10 x 10^{-3} s^{-1}

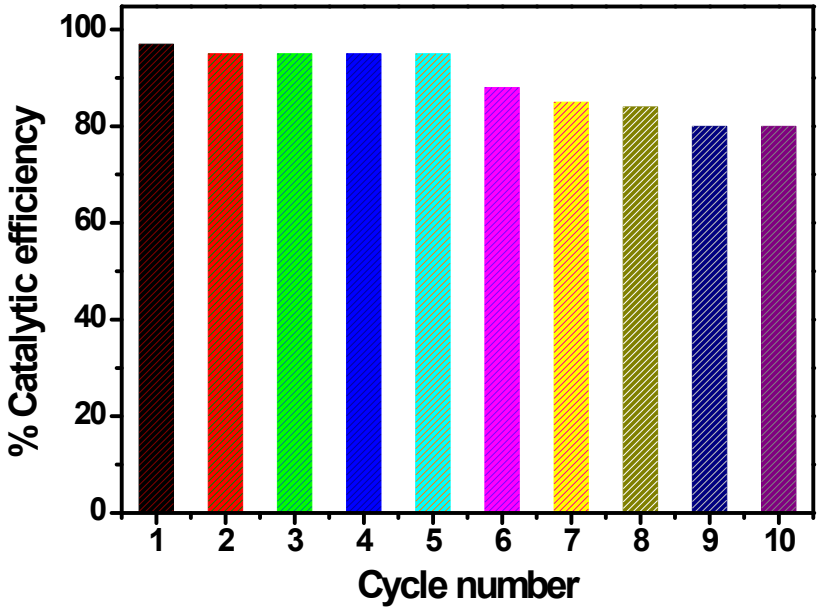

Fig. S27 Reduction of *p*-nitrophenol using AgNPs-GO-Chit was studied over ten successive cycles. Conditions: *p*-nitrophenol = 3 mL (0.01 mM); amount of AgNPs-GO-Chit = 5 mg; [$NaBH_4$] = 50 µL (0.1 mM) $NaBH_4$.

Table S1: Parameters of N_2 adsorption isotherm measurement

Samples[a]	**Surface area (m^2 g^{-1})**[b]
GR[c]	8.7
GO[d]	185
AgNPs-GO-Chitosan[e]	290
AuNPs-GO-Chitosan[f]	293

[a]50 mg of sample have been used for recording BET isotherm, [b]BET specific surface area was calculated from the linear part of the corresponding BET plot, [c]Pure graphite, [d]Graphene oxide, [e]GO grafted Chitosan stabilized AgNPs, [f]GO grafted Chitosan stabilized AuNPs,