Supporting Information

A magnetically separable and recyclable *g*-C_3N_4/Fe_3O_4/porous ruthenium nanocatalyst for the photocatalytic degradation of water-soluble aromatic amines and azo-dyes

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Chart S1. Chemical structure of aromatic amines used in this study.

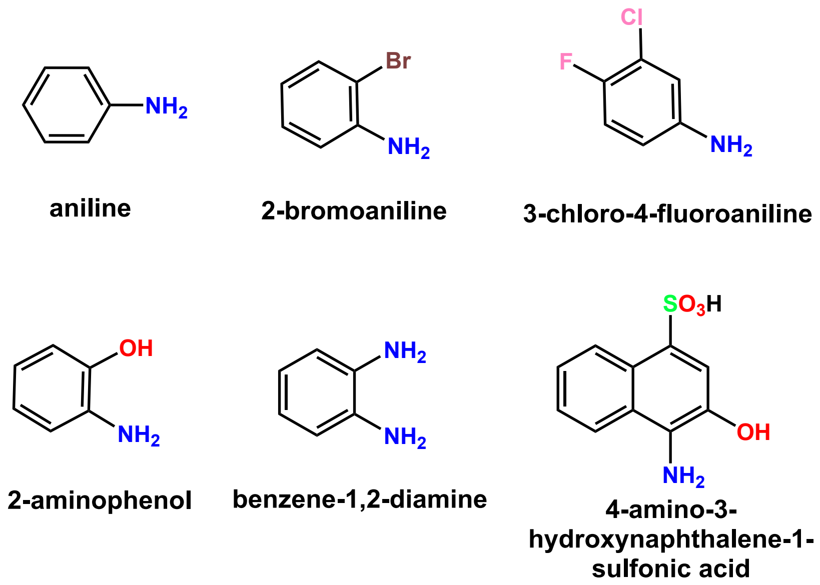
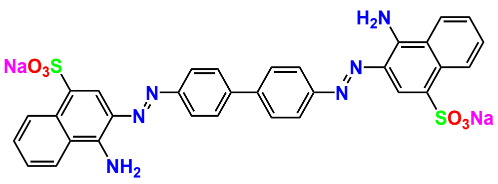
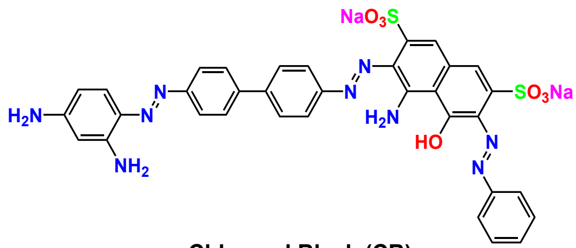


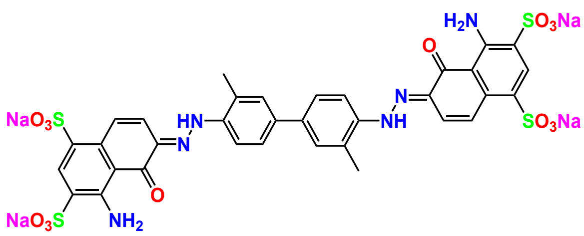
Chart S2. Chemical structure of azo dyes used in this study.



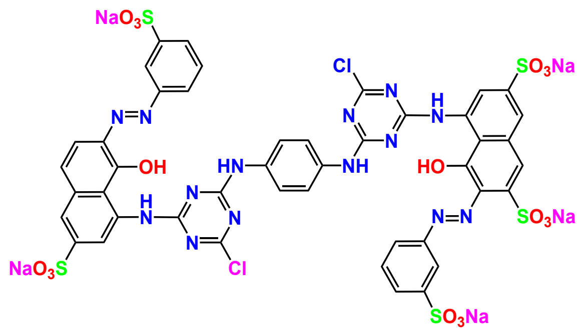
Congo Red (CR)



Chlorazol Black (CB)



Evans Blue (EB)



Reactive Red 120 (RR-120)

Table TS1. Comparison between the present and other related nanocatalysts towards removal of aromatic amines.

Sl. No.	Title	Name of the enzyme/ chemical/catalyst	Aromatic amine/hydroxy compounds used	Initial conc. of Dye/Aromatic amines	Medium/ Buffer/temp./pH	% removal
1	Chemical degradation of aromatic amines by **Fenton's reagent**[1]	**Fenton's reagent** [Fe(II) + H_2O_2] (100-500 mg/L)	o-dianisidine, 1-naphthylamine, 2-naphthylamine, 3,3'-dichlorobenzidine, p-anisidine, 4-chloroaniline, 2,4-iaminotoluene, o-tolidine and aniline.	0.0003 mM	pH 4.5-5.5	100
2	Removal of aromatic amines and decolourisation of azo dye baths by **electrochemical treatment**[2]	**Electrochemical treatment** 20 g of diatomaceous earth (90% SiO_2)	aniline, o-toluidine, 4-chloroaniline and 4-aminobiphenyl	300 mg/L Dye and 10mg/L Aromatic amines		90
3	**Chemical coagulation and sonolysis** for total aromatic amines removal from anaerobically pre-treated textile wastewater: A comparative study[3]	**Chemical coagulation, sonolysis** Magnesium chloride aided with aluminium chlorohydrate (1800 mg /L)	Azo dyes (CR, RB 5, Disperse blue 3) Aromatic amine: **Benzidine, sulfonic acid**	200 mg/L	pH 7.0	85 (AAs) 52 (Decolonization of dyes)
4	**Horseradish peroxidase** for the removal of carcinogenic aromatic amines from water[4]	**Horseradish peroxidase** (100U/L) and hydrogen peroxide(1M)	o-tolidine, and 2-naphthylamine; from Aldrich, 1-naphthylamine, 4-aminobiphenyl, pphenylazoaniline, aniline, p-toluidine	100mg/L	pH 5.0	99
5	Removal of direct azo dyes and aromatic amines from aqueous solutions using **two -cyclodextrin-based polymers**[5]	**b-Cyclodextrin** (b-CD) (2.5 g/L)	benzidine, p-chloroaniline and -naphthalamine	0.001 mM	pH 7.0	>85
6	Removal efficiency of a **calix[4]arene-based polymer** for water-soluble carcinogenic direct azo dyes and aromatic amines[6]	**calix[4]arenes derivative** (2.5 g/L)	Azo dyes and aromatic amines (benzidine, p-chloroaniline, -naphthalamine)	0.001 mM	pH 2.0	>90

7	A **porous trimetallic Au@Pd@Ru** nanoparticle system: synthesis, characterisation and efficient dye degradation and removal[7]	Porous Au@Pd@Ru **Dolochar(150g/L**)	Benzedine,benzidine, 4-aminophenol and 3,4 dimethoxyaniline	Dye and Aromatic amines= 1mM	pH=7.0	>90
8	A Combined Process for the Degradation of Azo-Dyes and Efficient Removal of Aromatic Amines Using Porous Silicon Supported Porous Ruthenium Nanocatalyst[8]	Porous silicon@ porous ruthenium(8 mL in 1 L) and H_2O_2(1M) (amount of Ru ≈ 3.39 ppm)	Azo dyes and aromatic amines	Dye and Aromatic amines= 1mM	pH=5.0	46-99
9	A magnetically separable and recyclable porous Ruthenium nanocatalyst for the photocatalytic degradation of water-soluble aromatic amines and azo-dyes[Present Work]	80 mg/L 100 W, visible LED light (amount of Ru ≈ 3.44 ppm)	Azo dyes and aromatic amines	Dye(200mg/L) Aromatic amines (100-200mg/L)	pH 7.0	The percentage varies from 67-99 And the catalyst is recyclable several times

Table TS2. Catalytic reduction of azo dyes in presence of *g*-C_3N_4/Fe_3O_4/*p*-RuNP nanocomposites and $NaBH_4$.

Sr. No	Name of the dye/amine	Concentration	Catalyst (per 10 mL)	Time of reaction	Removal efficiency
1	**CR**	5 mg/L	200 µL	1 h	100 %
2	**CB**	5 mg/L	200 µL	1 h	100 %
3	**EB**	5 mg/L	200 µL	18 h	100%
4	**RR-120**	5 mg/L	200 µL	2 h	98%

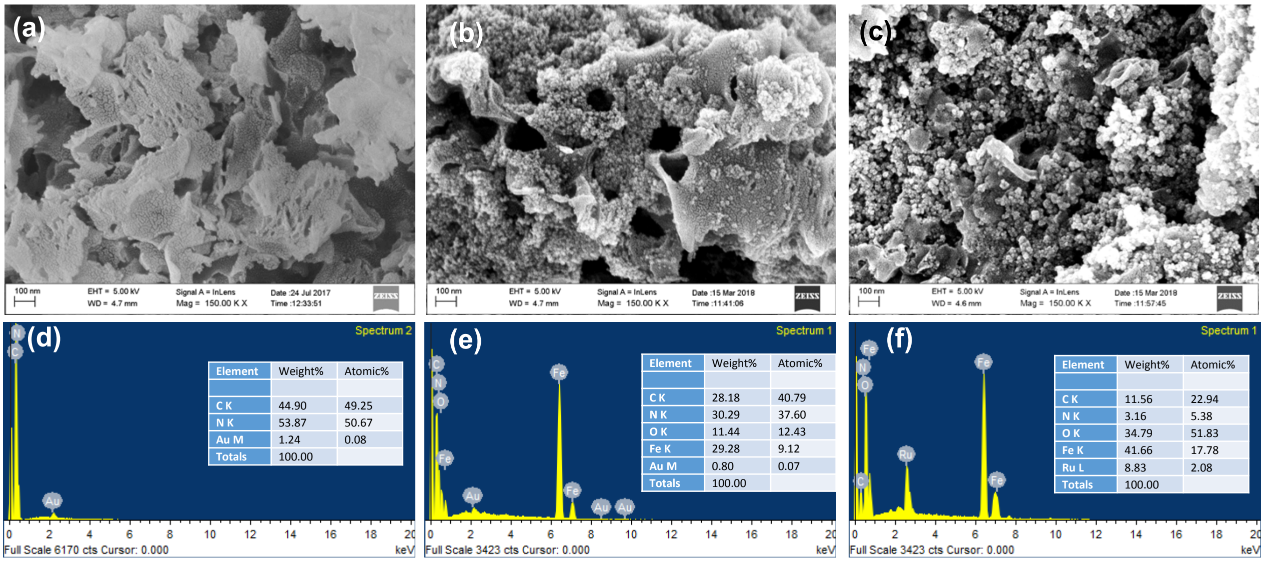


Figure S1. FE-SEM images of (a) *g*-C_3N_4 nanosheet, (b) *g*-C_3N_4/Fe_3O_4NP and (c) *g*-C_3N_4/Fe_3O_4/*p*-RuNP nanocomposites and (d-f) their corresponding EDS spectra, respectively.

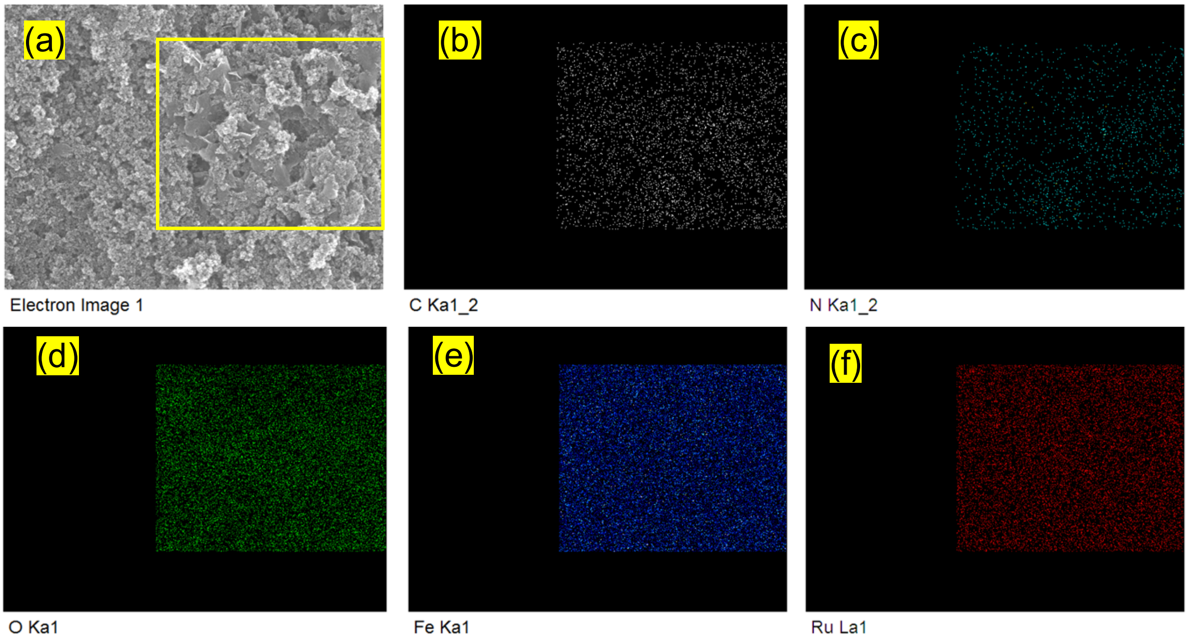


Figure S2. SEM image (a) and mapping of (b) elemental C, (c) elemental N, (d) elemental O (e) elemental Fe and (f) elemental Ru of *g*-C_3N_4/Fe_3O_4/*p*-RuNP nanocomposite.

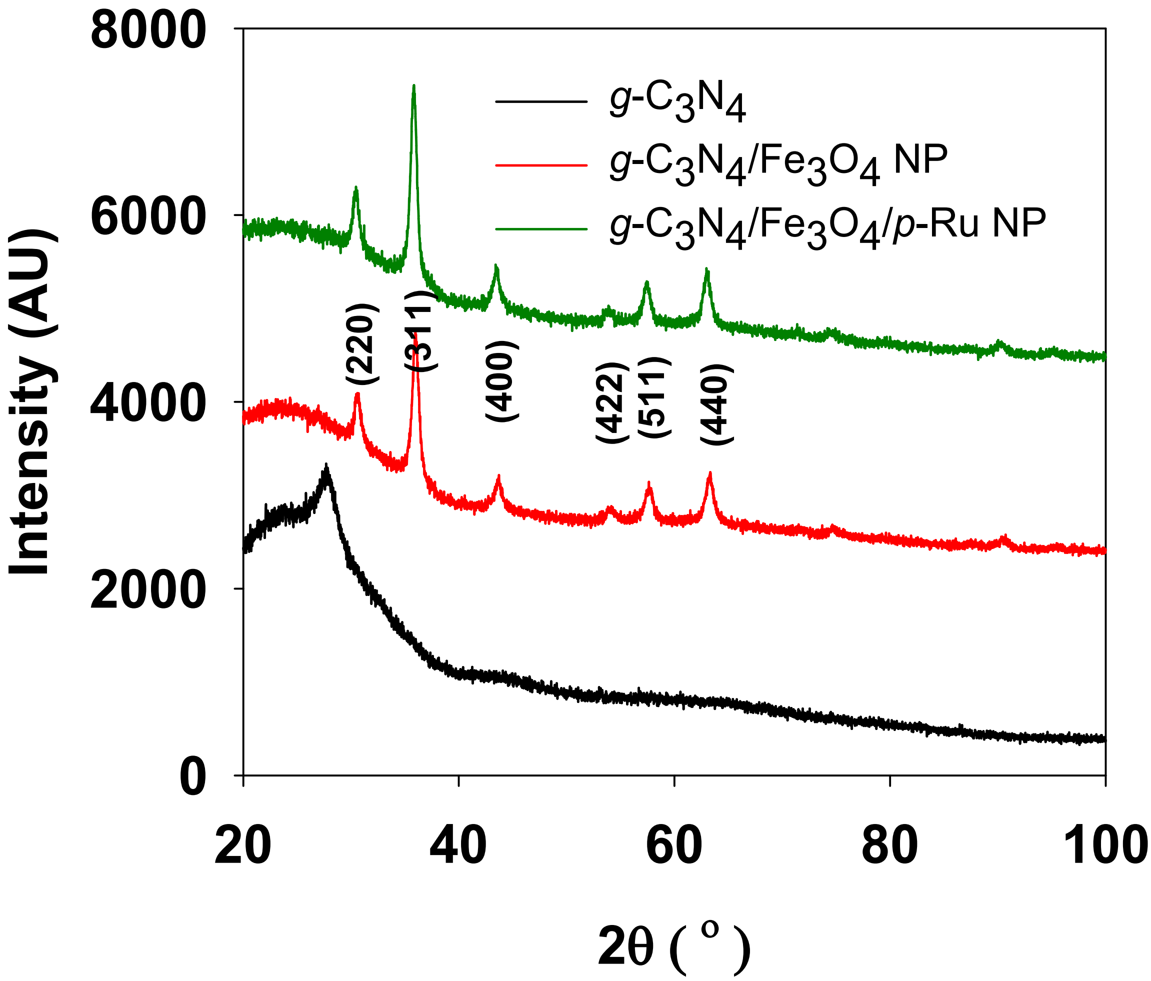


Figure S3. Powder XRD patterns of *g*-C_3N_4 nanosheet, *g*-C_3N_4/Fe_3O_4NP and *g*-C_3N_4/Fe_3O_4/*p*-RuNP nanocomposites.

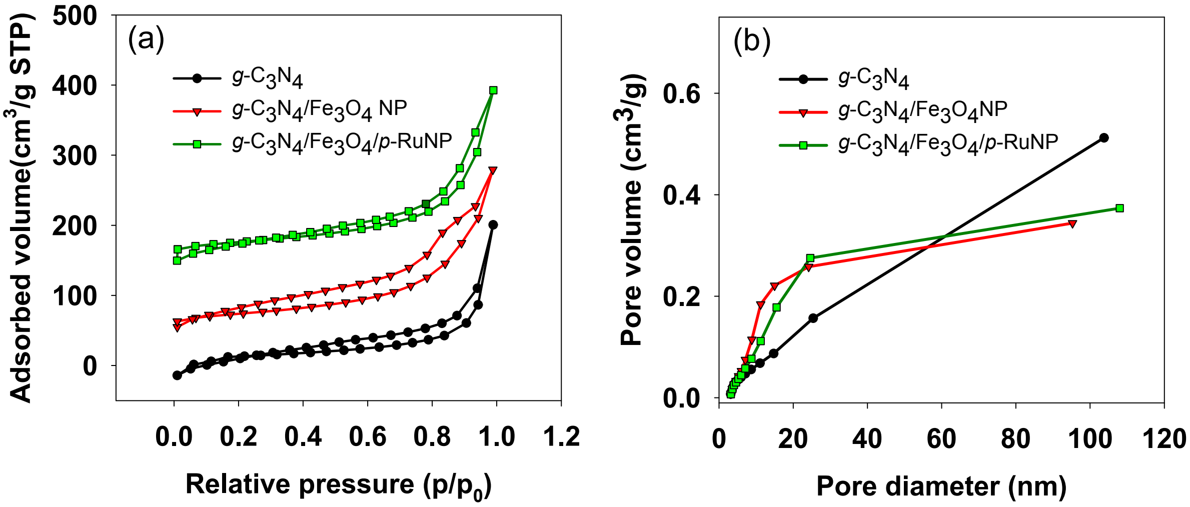


Figure S4. (a) N_2 adsorption-desorption isotherms and (b) pore size distribution of *g*-C_3N_4, *g*-C_3N_4/Fe_3O_4NP and *g*-C_3N_4/Fe_3O_4/*p*-RuNP nanocomposites.

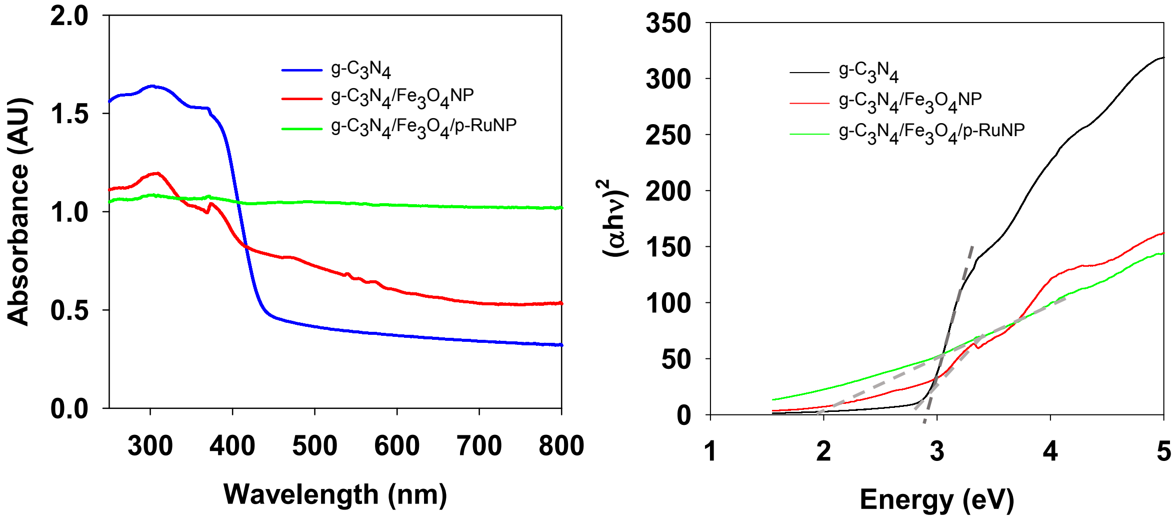


Fig. S5. (a) UV-Vis DRS spectra and (b) Tauc plot of *g*-C_3N_4, *g*-C_3N_4/Fe_3O_4NP and *g*-C_3N_4/Fe_3O_4/*p*-RuNP.

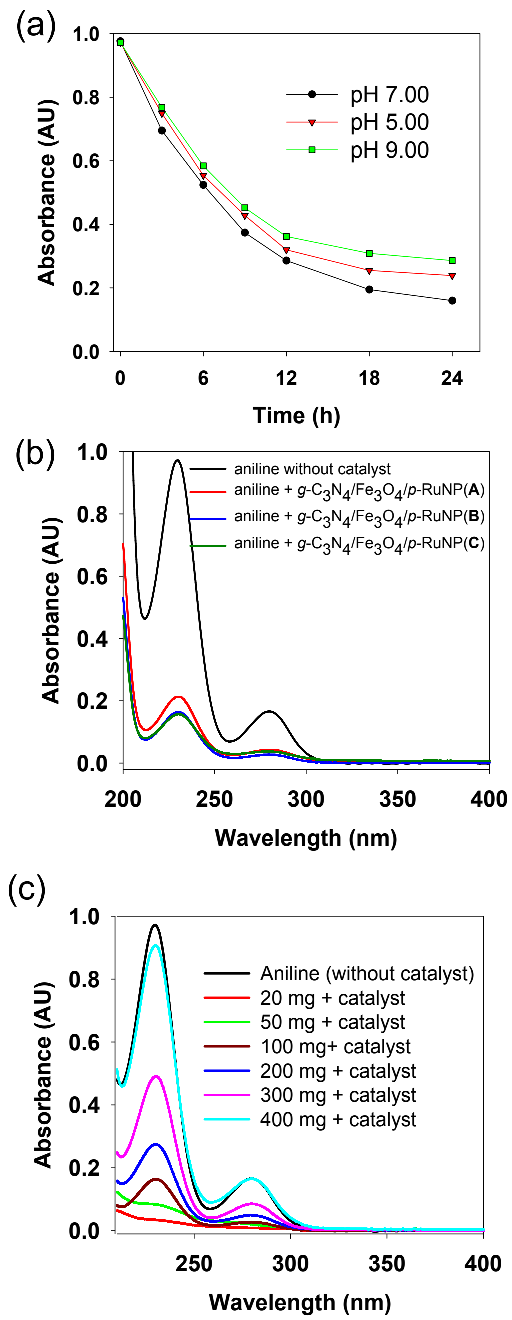


Figure S6. Photocatalytic degradation of aniline (100 mg/L) by *g*-C_3N_4/Fe_3O_4/*p*-RuNP at (a) different pH (b) with varying ruthenium concentration and (c) varying aniline concentration after 24 h under LED.

* catalysts were taken 80 mg containing 3.44 ppm of Ru^0; The catalysts **A**, **B** and **C** were prepared by taking 5 mM, 10 mM and 20 mM $RuCl_3$. nH_2O.

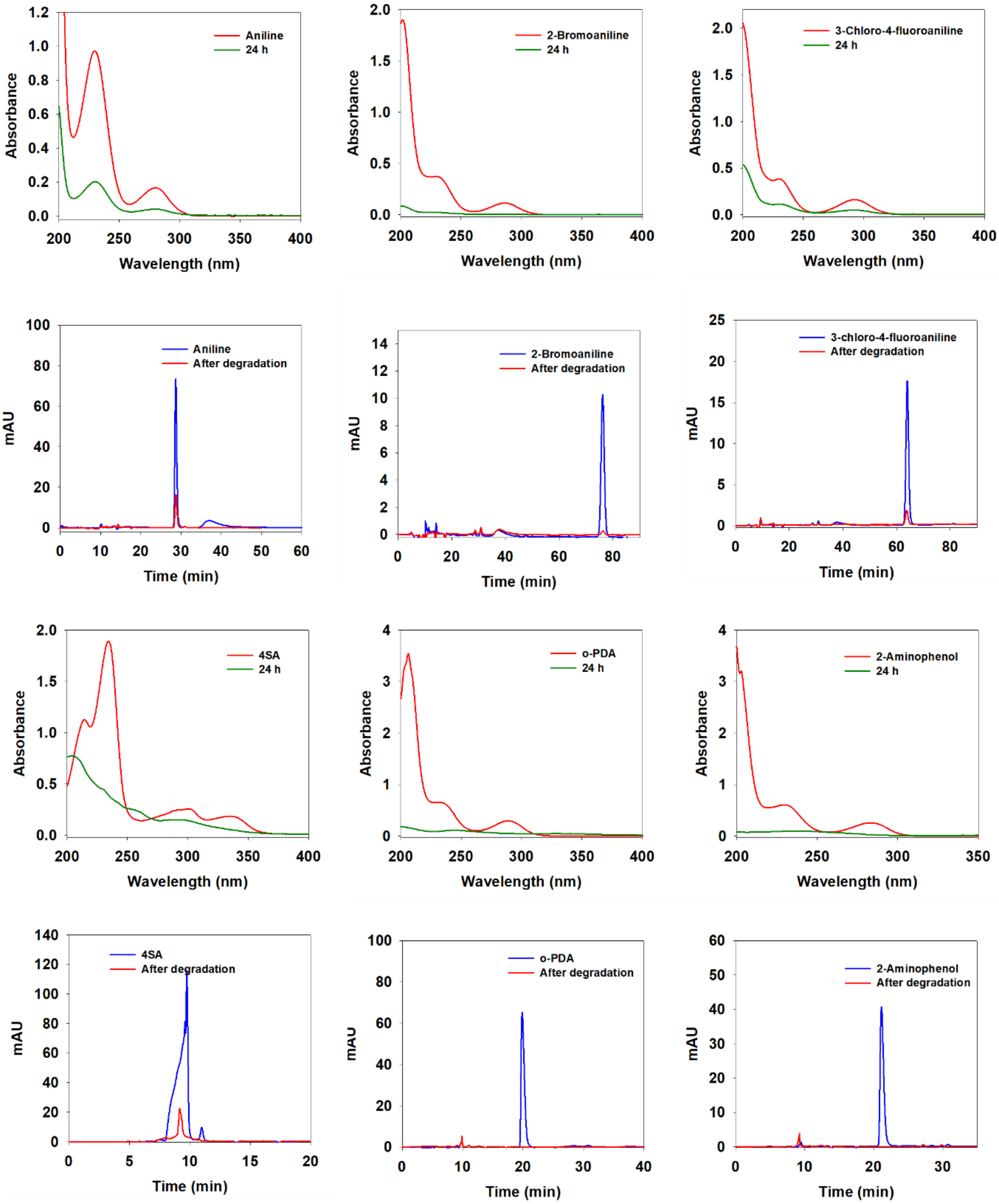


Figure S7. UV-Vis spectra and HPLC of aromatic amines (100 mg/L) and after degradation using visible light at pH 7.0 in presence of *g*-C_3N_4/Fe_3O_4/*p*-RuNP nanocatalyst (80 mg/L).

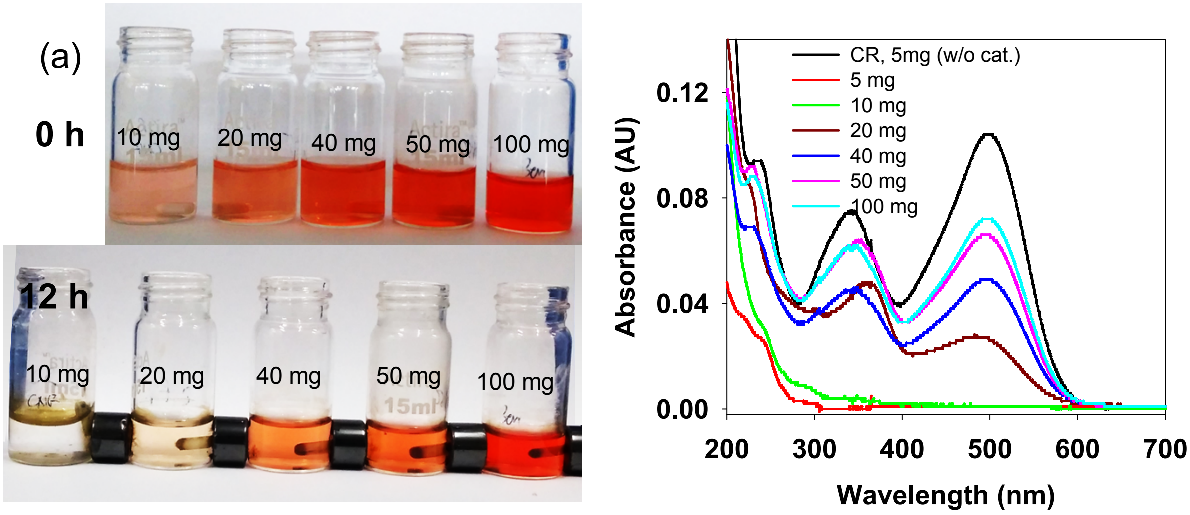


Figure S8. Photograph of CR dye of varying concentration (a) before and (b) after photodegradation (12 h) by *g*-C_3N_4/Fe_3O_4/*p*-RuNP nanocomposite and (c) the corresponding UV-Vis spectra.

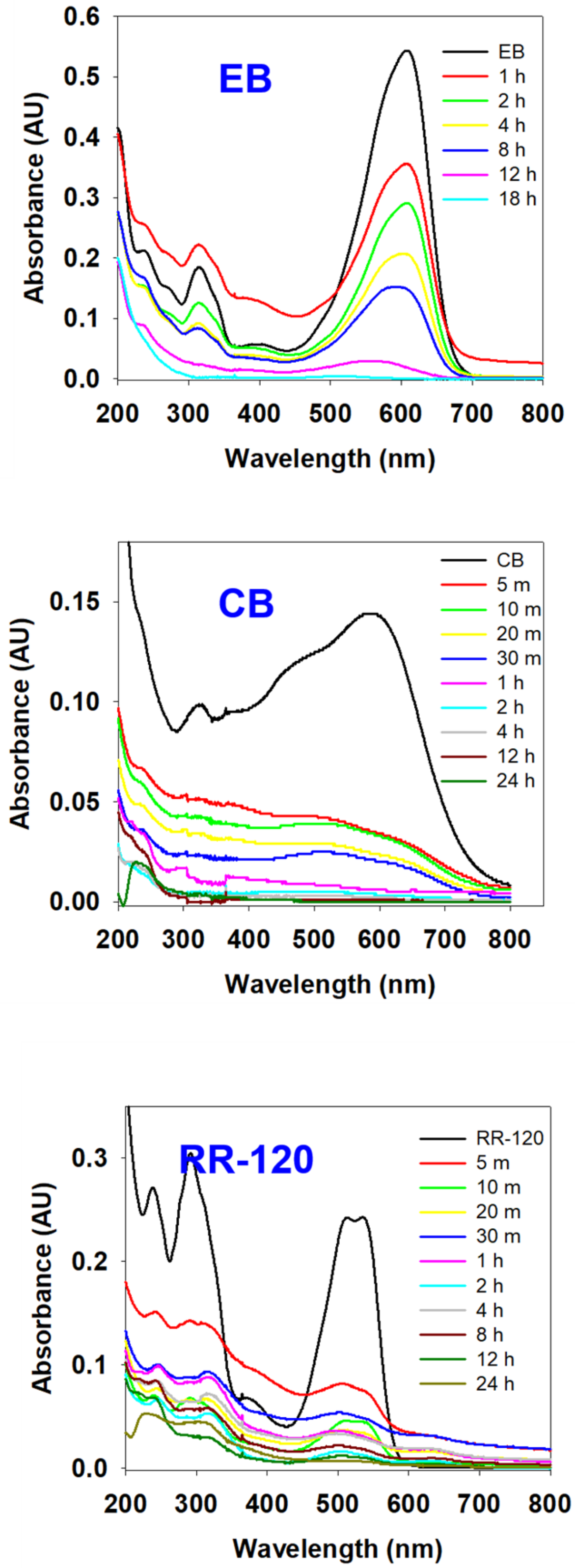


Figure S9. UV-Vis spectra of degradation of various azo dyes (5 mg/L) under LED in presence of *g*-C_3N_4/Fe_3O_4/*p*-RuNP nanocatalyst (80 mg/L).

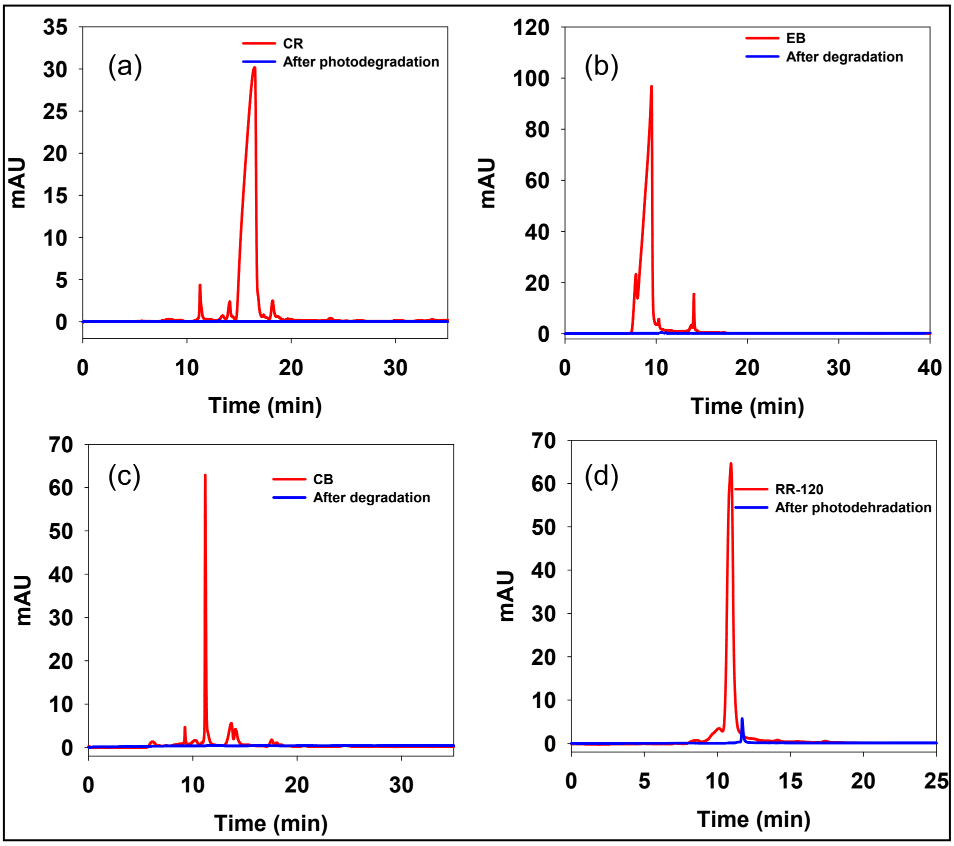


Figure S10. HPLC of azo-dyes (5 mg/L) after and before the degradation using visible light at pH 7.0 in presence of *g*-C_3N_4/Fe_3O_4/*p*-RuNP (80 mg/L) nanocatalyst.

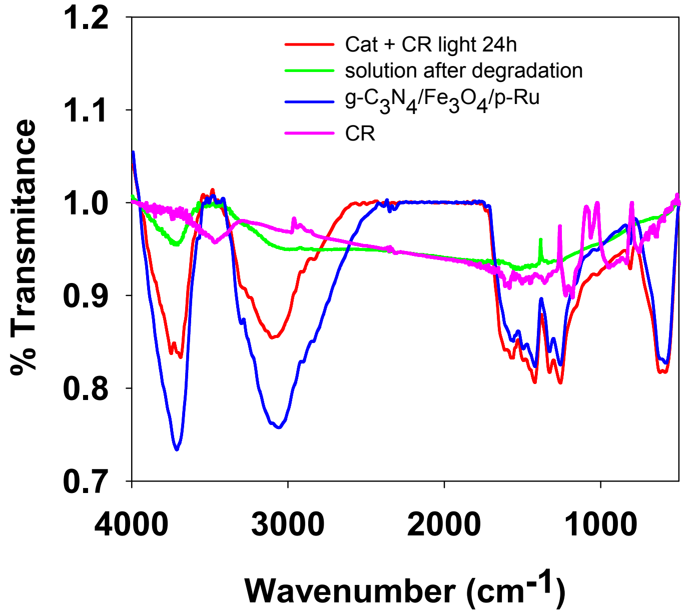


Figure S11. FTIR spectra of CR, *g*-C_3N_4/Fe_3O_4/*p*-RuNP nanocatalyst before and after photo-degradation of CR and the solution after complete degradation of CR.

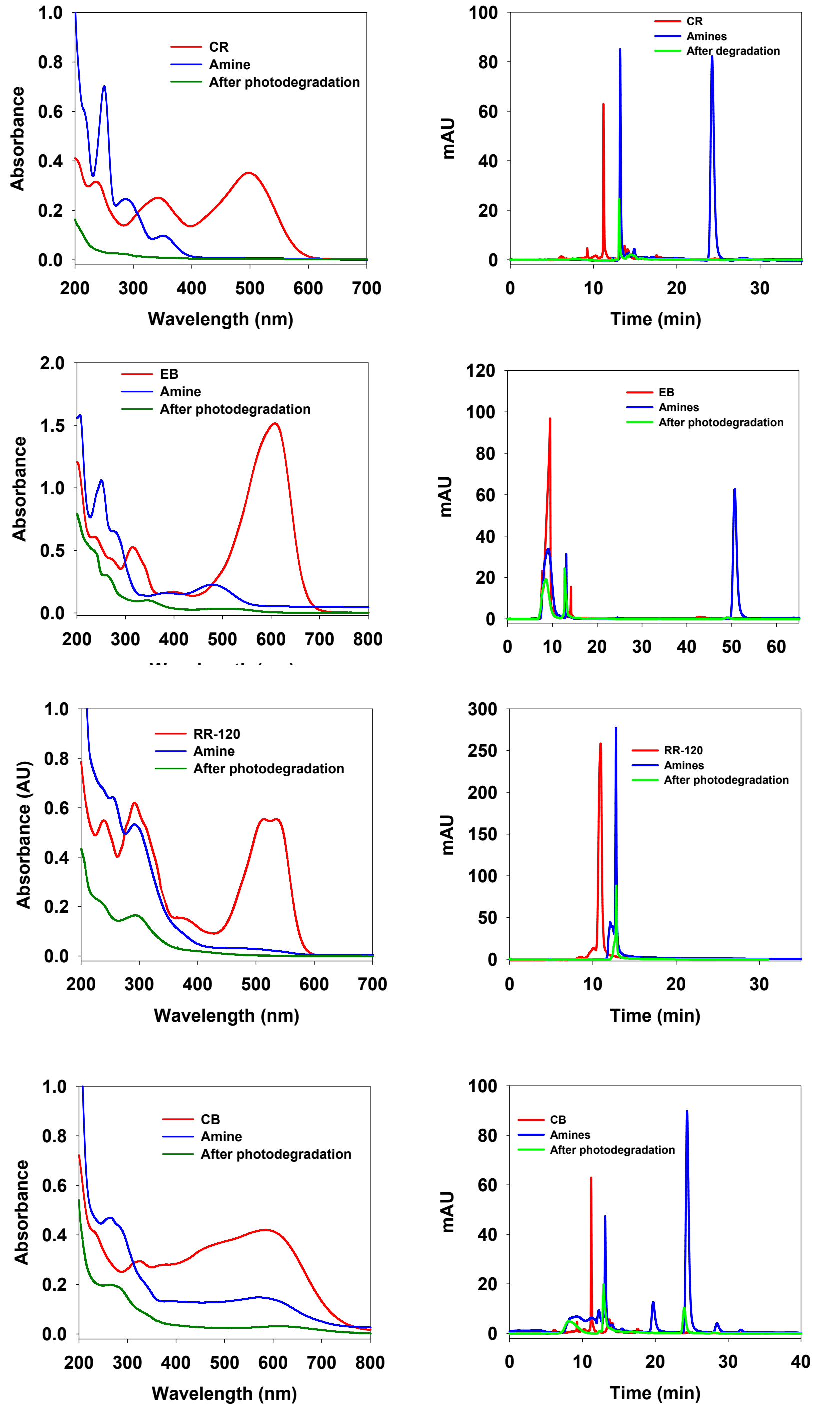


Figure S12. (a, c, e and g) UV-Vis spectra of azo dyes before (i), after(ii) reduction and after photo-degradation (iii); (b, d, f and h) HPLC of aromatic amines of reduced dyes (200 mg/L) after and before degradation using visible light at pH 7.0 in presence of *g*-C_3N_4/Fe_3O_4/*p*-RuNP nanocatalyst (80 mg/L).

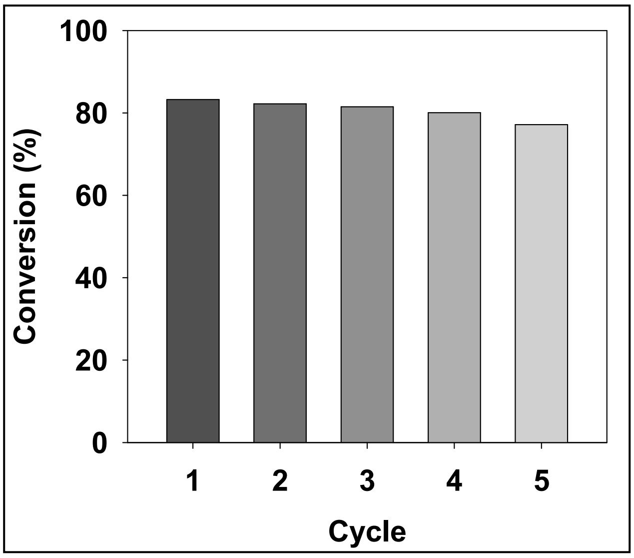


Figure S13. Reusability of *g*-C_3N_4/Fe_3O_4/*p*-RuNP nanocatalyst towards aniline (100 mg/L) degradation under visible (LED) light.

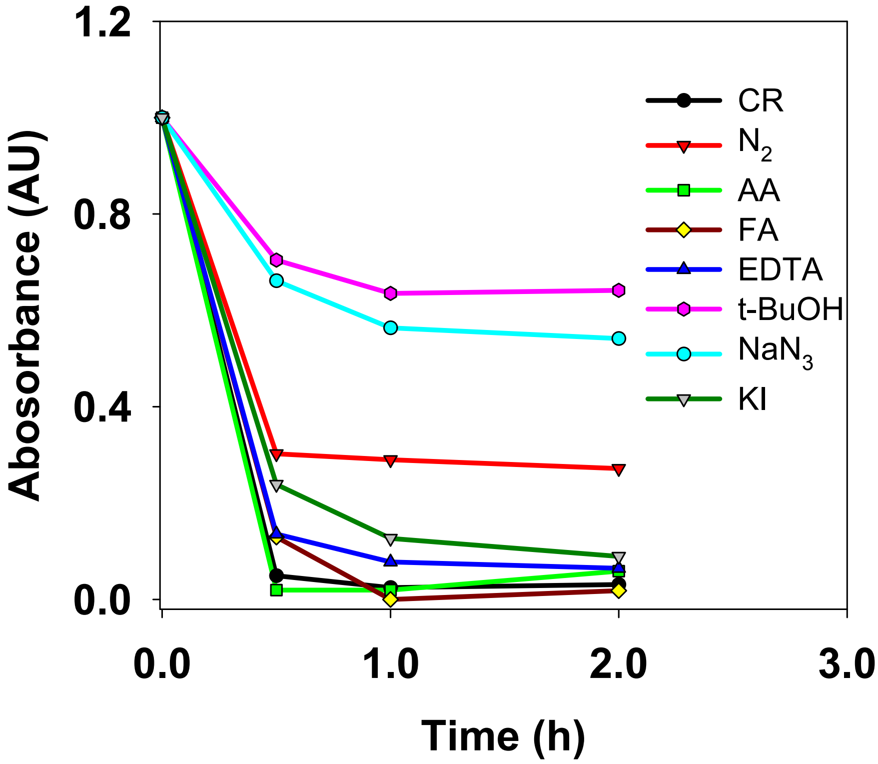


Figure S14. (a) UV-Vis spectra of congo red (CR) after treatment of *g*-C_3N_4/Fe_3O_4/*p*-RuNP nanocatalyst in the presence of different radical scavengers under LED light.

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