

Supplementary Information

Robust and highly compressible polyacrylamide co-polymer hydrogel developed through g-C₃N₄ initiated photopolymerisation and its photocatalytic activity towards dye removal

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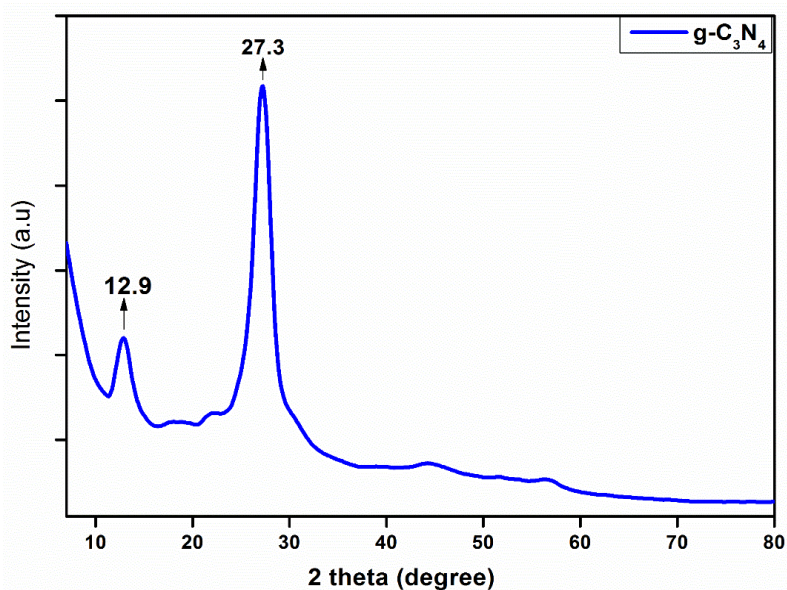


Figure S2. Powder X-ray diffraction pattern of the synthesized g-C₃N₄

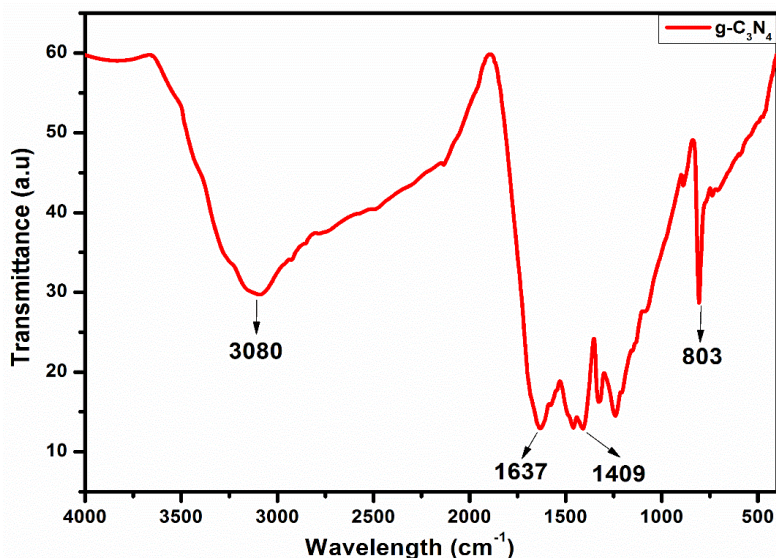


Figure S2. Fourier Transform Infrared Spectra of the synthesized g-C₃N₄

The XRD pattern for g-C₃N₄ shows two peaks at around 13° and 27°. The small characteristic peak at around 13° represents (1 0 0) facet which arises due to in-planar tri-s-triazine unit. The strongest characteristic peak at around 27° is indexed as (002) facet, which is usually seen in graphitic materials because of the interaction of the interlayer stacking in the conjugated aromatic system. (Figure S1)

In the FTIR spectra, the peak at 3080 cm⁻¹ is due to the N-H group vibration present at the surface of carbon nitride or due to the stretching mode of -NH₂ group which are uncondensed amine groups. The strong bands at 1637cm⁻¹ and 1407 cm⁻¹ were assigned to the aromatic CN stretching vibration. The intense peak at 803 cm⁻¹ is attributed to the C-N heterocycles and is the characteristic peak of the triazine molecule. (Figure S2)

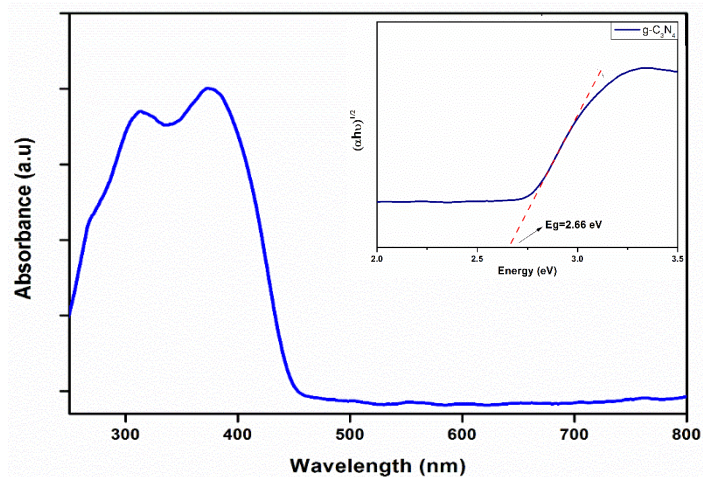


Figure S3. UV-Visible absorbance spectra and Band gap energy of the synthesized $g\text{-C}_3\text{N}_4$

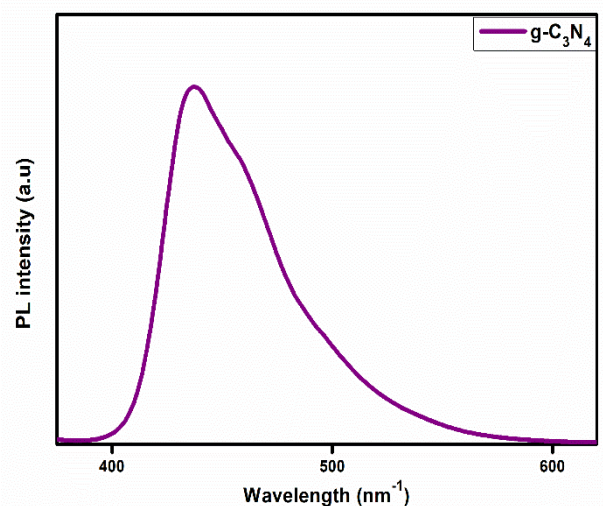


Figure S4. PL spectra of synthesized bulk $g\text{-C}_3\text{N}_4$

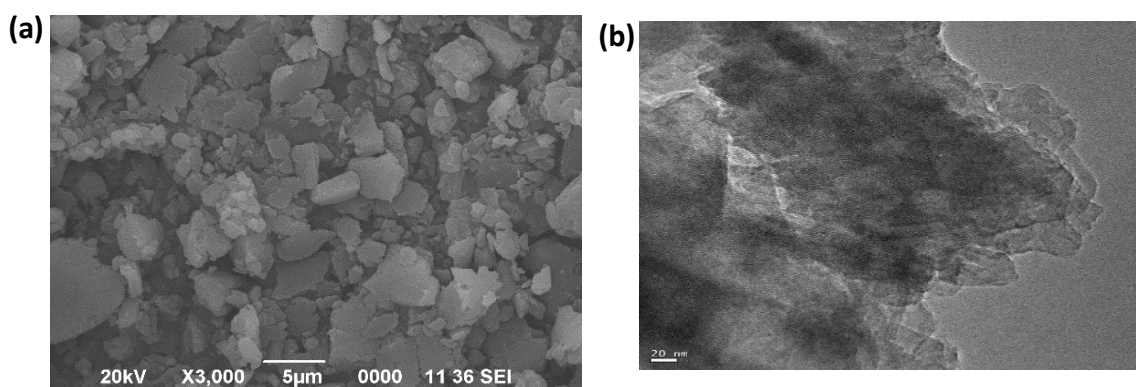


Figure S5. (a) SEM image, and (b) TEM image of the synthesized $g\text{-C}_3\text{N}_4$

The morphological structure of the $g\text{-C}_3\text{N}_4$ as shown from the SEM image reveals disorderly stacked layers consisting of heterogeneously distributed and agglomerated structures which was further confirmed by its TEM images.

S6. Synthesis of blank hydrogel (CN0): 0.8g of AMPS and 0.4g of AAm were taken in a glass vial with 5 mL of deionized water. 1 wt % MBA was then added to the prepared solution as a crosslinker. APS was dissolved in 1mL of water and added dropwise to the prepared solution. The mixture was then flushed with nitrogen for 15 mins and the reaction was kept on stirring for almost 4 hours. The obtained hydrogel was washed several times and dried for further use

Table S1. Detailed composition of the CN hydrogels

Sl.no.	AAm (mg)	AMPS (mg)	g-C ₃ N ₄ (wt% of total monomer content)	Crosslinker (mg)	N ₂	Light	Hydrogel
1	400	800	0.8	12	✓	✓	CN 0.8
2	400	800	1	12	✓	✓	CN1
3	400	800	2	12	✓	✓	CN2
4	400	800	3	12	✓	✓	CN3
5	400	800	4	12	✓	✓	CN4
6	400	800	5	12	✓	✓	CN5
7	400	800	0	12	✓	✓	No reaction
8	400	200	8	12	✓	✓	CN6
9	400	200	8	12	×	✓	No reaction
10	400	200	8	12	×	×	No reaction
11	400	200	8	12	✓	×	No reaction
12	400	200	8	0	✓	✓	Gel formed dissolves in water



Figure S7. Photographic image showing compression of the hydrogel (a) uncompressed, and (b) compressed

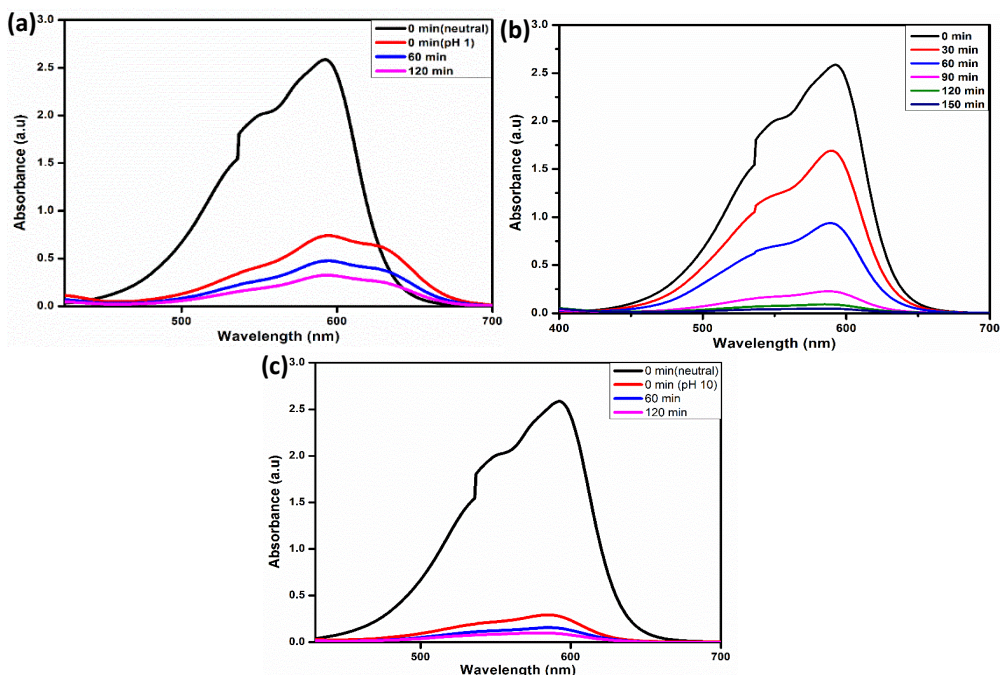


Figure S8. UV-Visible absorbance spectra of the dye molecule treated at different solution of (a) pH 1, (b) neutral (pH 7) and (c) pH 10 under light irradiation at definite time interval

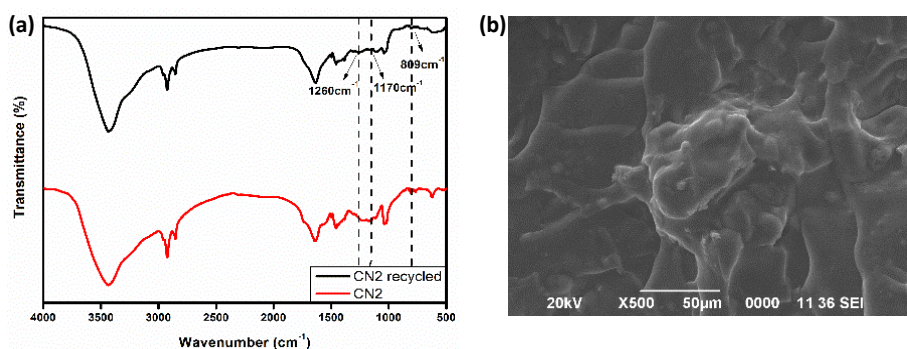


Figure S9. FTIR spectra of the hydrogel before and after recycling and (b) SEM morphology of the hydrogel after recycling

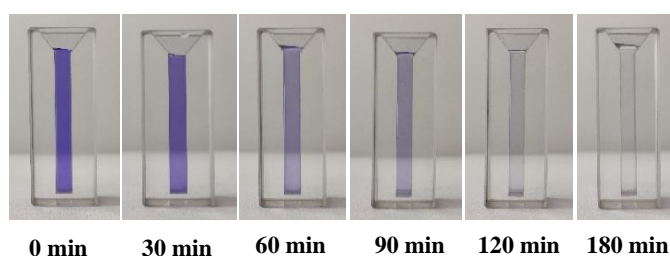
FTIR spectra of the CN hydrogel after the 5th cycle showed no appreciable change. However, there is a small decrease in intensity in the range of 1250cm^{-1} to 1150cm^{-1} . The decrease in intensity around 1250cm^{-1} is due to the electrostatic interaction of the C-N group of the hydrogel with residual CV dye molecules. Similarly, the decrease in intensity around 1170cm^{-1} is due to the interaction of the $-\text{SO}_3$ group of hydrogels with the CV dye molecules. The small peak at 809cm^{-1} depicts the presence of $\text{g-C}_3\text{N}_4$ in the dye-treated hydrogel. The SEM morphology of the hydrogel after the 5th cycle demonstrates a nonporous and smooth wavy surface which is due to the subsequent drying and swelling process that causes a change in morphology on the hydrogel surface. Therefore, the above results indicate that, although the hydrogel shows recyclability up to 5 cycles, a small portion of residual dye molecules got adsorbed within the hydrogel matrix thereby causing small changes in the structure and morphology of the dye-treated hydrogel.

Table S2. Isotherm parameters for adsorption of CV dye by CN hydrogel

Models	Parameters	
Langmuir	q_{\max} (mg/g)	100
	K_L (Lmg ⁻¹)	2.5
	R^2	0.996
Freundlich	1/n	0.626
	K_F	75.18
	R^2	0.96

Table S3. Kinetic parameters for adsorption of CV dyes by CN hydrogel with different adsorbent dosage

Adsorbent dosage (mg)	q_e (exp.) (mg/g)	Kinetic model					
		Pseudo-first order			Pseudo-second order		
		k_1 (g/mg.h)	q_e (cal) (mg/g)	R^2	k_2 (g/mg.h)	q_e (cal) (mg/g)	R^2
25	12.18	0.25	10.89	0.960	0.03	13.94	0.995
50	6.09	0.18	4.18	0.968	0.059	6.61	0.998
75	4.03	0.267	4.61	0.985	0.052	4.76	0.970
100	3.04	0.265	2.57	0.955	0.144	3.28	0.994

**Figure S10.** Photographic image showing dye removal by the hydrogel under light irradiation at definite time interval