Supporting Information

Dipicolinic Acid Modified Carbon Nitride for Photocatalytic Degradation of Acid Violet 7 dye and Charge Storage Application

Pritam Ramteke [a], Suraj W. Wajge [b], Sachin G. Ghugal [c], Kiran Kumar Tadi [d], R. Gowthami [d], and Suresh S. Umare [a, *]

[a] Materials and Catalysis Laboratory, Department of Chemistry, Visvesvaraya National Institute of Technology (VNIT), Nagpur 440010, India

[b] Composite and Functional Material Laboratory, Department of Chemistry, Visvesvaraya National Institute of Technology (VNIT), Nagpur 440010, India

[c] Carbon Resources Conversion Research Center, Korea Institute of Energy Technology (KENTECH), Naju, Jeollanamdo, 58217, Republic of Korea

[d] Energy, Electrodics and Electrocatalysis (EEE) Lab, Department of Chemistry, School of Advanced Sciences, Vellore Institute of Technology, Chennai 600127, Tamil Nadu, India

Corresponding author Email: ssumare1965@gmail.com

1. Material Characterization

The powder X-ray diffraction (p-XRD) pattern was recorded on Brucker D8 advance ECO diffractometer (USA) operated at 40 kV and 25 mA using Cu Kα radiation (α = 1.5418 Å). Fourier transform infrared (FT-IR) spectrum was recorded on Nicolet iS50 FTIR spectrometer (Thermo Fisher Scientific, USA) using KBr pellets in the range 4000-400 cm^{-1}. Raman spectroscopy was performed on model: HEDA-URSM4/5/7 (NOST, Korea) with excitation laser source at 532 nm. An X-ray photoelectron spectrometer (XPS) ESCALAB 250-Xi (Thermo Fisher Scientific, USA) was used for elemental analysis. CasaXPS software was used for XPS spectra deconvolution and data processing. The optical absorption of the solid materials was measured by an ultraviolet-visible diffuse reflectance spectrophotometer (UV-Vis DRS) on UV-2600, Shimadzu, Japan. The surface morphology of the catalysts was imaged using a field emission scanning electron microscope (FE-SEM) JSM-6701F (JEOL, Japan). The microstructure of the materials was analyzed by transmission electron microscope (TEM) JEM-2100 (JEOL, Japan) with an accelerating voltage of 200 kV. The analysis of the Acid violet 7 (AV7) dye was measured by an ultraviolet-visible (UV-Vis) spectrophotometer (UV-1800, Shimadzu, Japan). Brunauer-Emmett-Teller (BET) surface area was measured using the Nova touch surface area analyzer NT1-1 (Quantachrome, USA). Steady-state photoluminescence (PL) emission spectra were recorded on a spectrofluorometer FL-1039/40 (Horiba Jobin Yvon, USA) at an excitation wavelength of 320 nm. Cross polarized magic angle spinning (CP-MAS) solid-state ^{13}C nuclear magnetic resonance (^{13}C NMR) spectrum was recorded using ECX400 (JEOL, Japan). Total organic carbon (TOC) was analyzed using Enviro TOC (Elementar, Germany Thermogravimetric analysis (TGA) was performed using thermogravimetric analyzer (TG-DTA 7200, Hitachi, Japan).

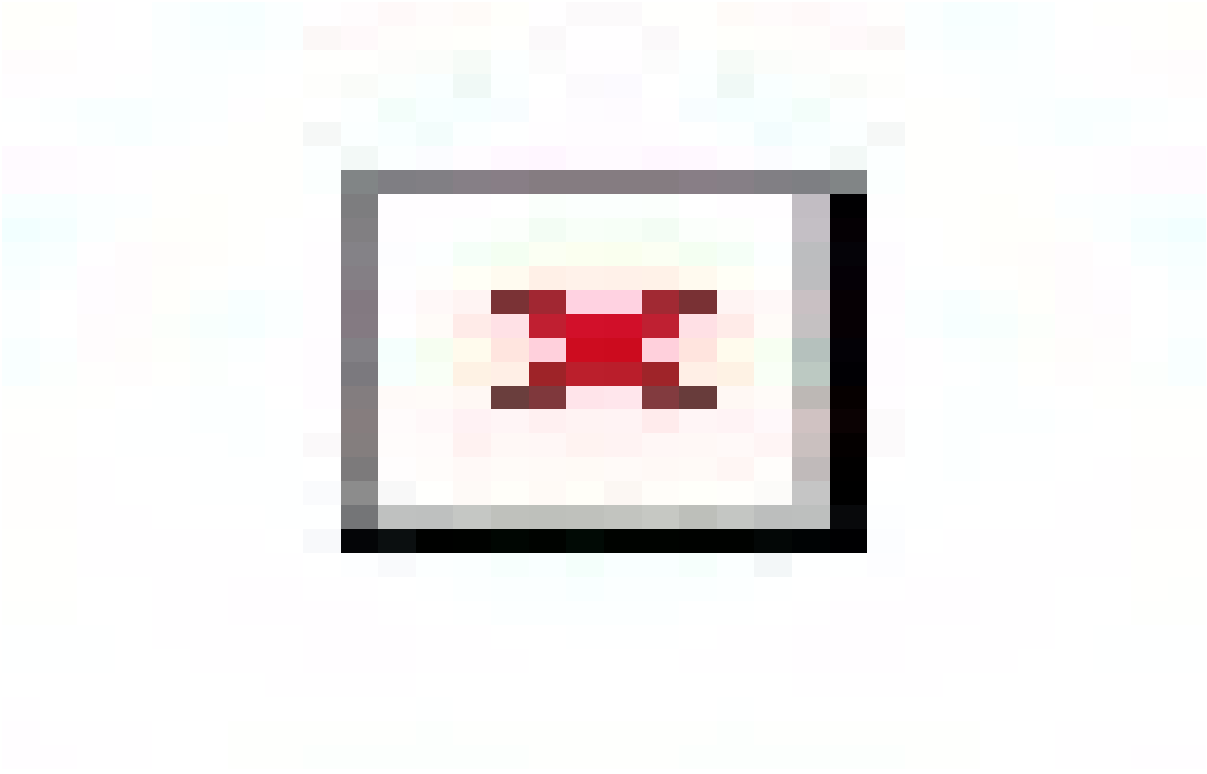


Fig. S1. (a, b) Field emission scanning electron microscopy (FESEM) images and (c, d) EDAX spectrum of PCN and 10DPA-CN.

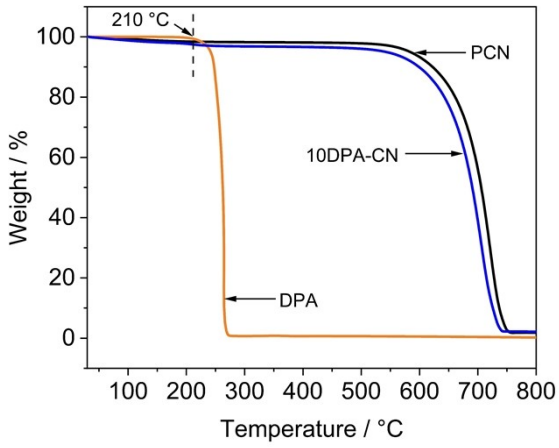
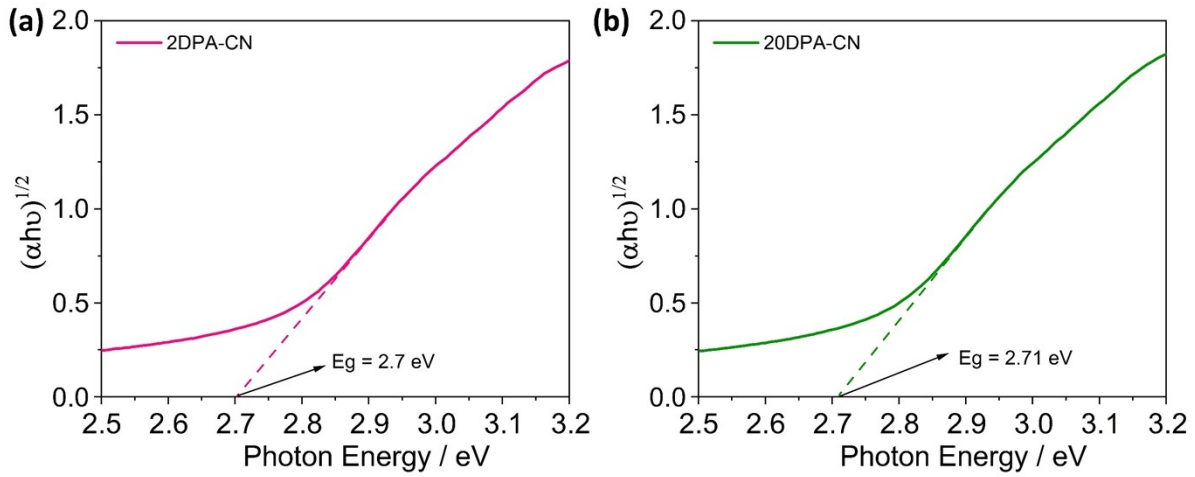


Fig. S2. Thermogravimetric analysis (TGA) curves of PCN, DPA, and 10DPA-CN.



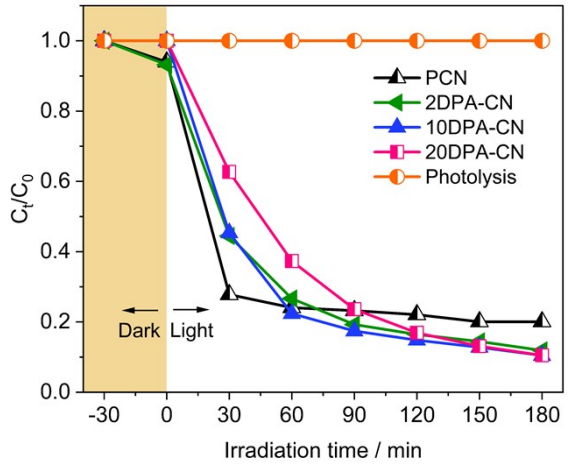
64

65 **Fig. S3. Tauc plots derived from Kubelka-Munk functions of (a) 2DPA-CN and (b)**
66 **20DPA-CN.**

67

68

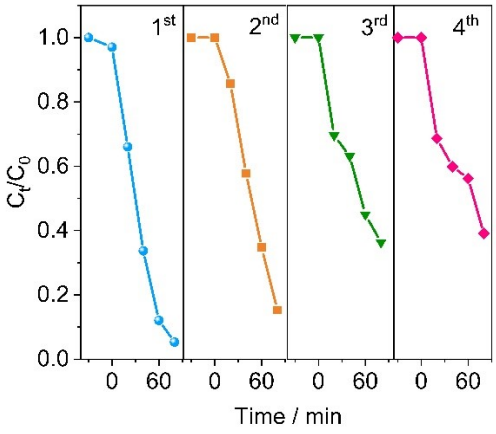
69



70

71 **Fig. S4. Photocatalytic degradation of TCH using PCN and xDPA-CN catalysts.**

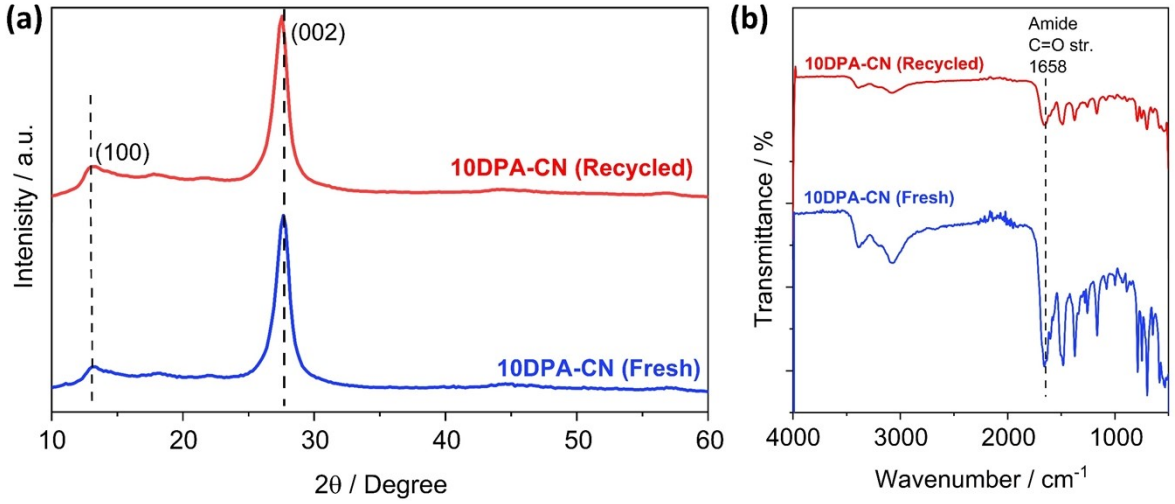
72



73

74 **Fig. S5. Recyclability test of 10DPA-CN for consecutive four repeated cycles for**
75 **photocatalytic degradation of AV7 dye.**

76



77

78 **Fig. S6. (a) pXRD and (b) FTIR spectra of freshly prepared and recycled 10DPA-CN**
79 **catalyst after 4th repeated cycle of photocatalytic degradation of AV7 dye.**

80

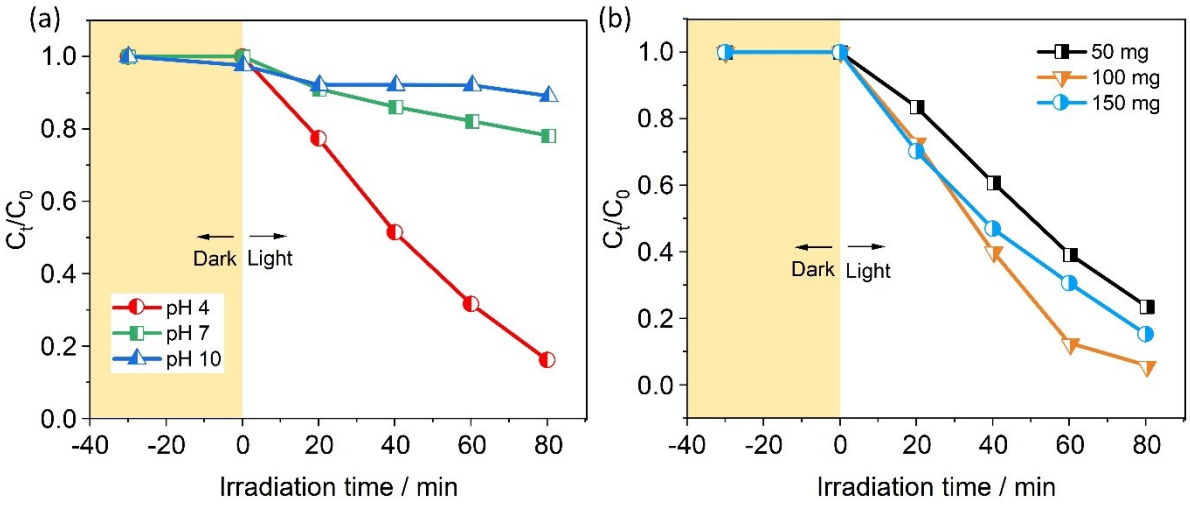


Fig. S7. (a) Effect of pH and (b) catalyst dose optimization for photocatalytic degradation of AV7 over 10DPA-CN catalyst.

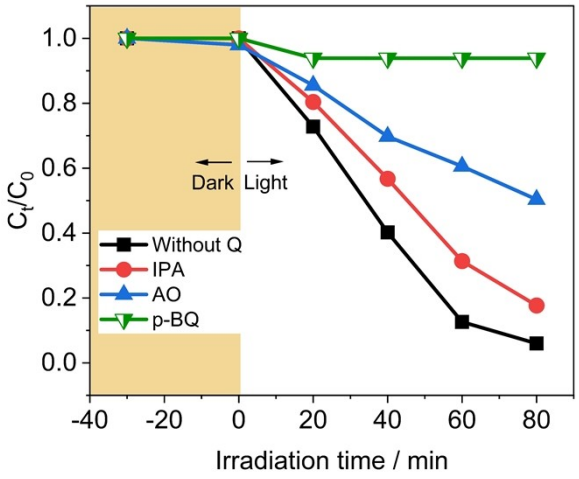


Fig. S8. Effect of quenchers on AV7 degradation over 10DPA-CN catalyst.

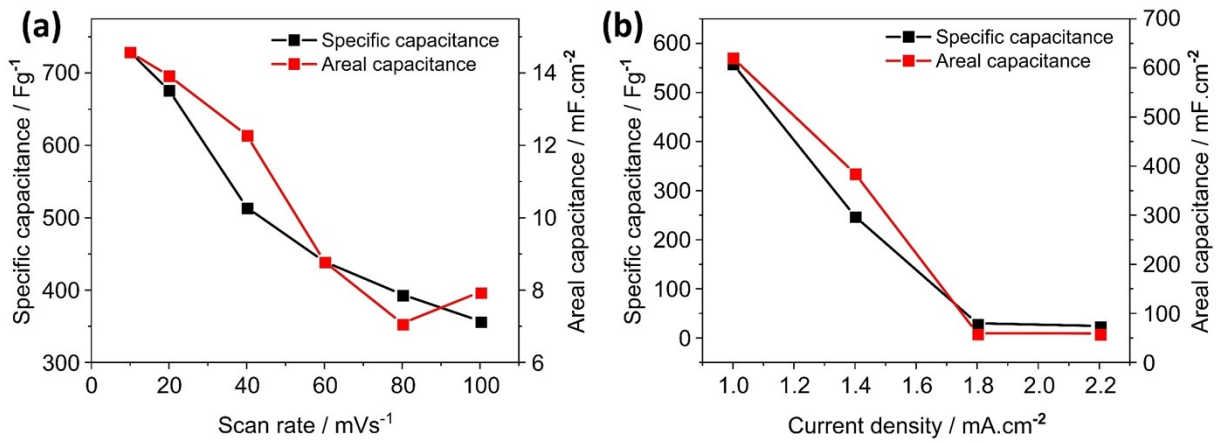


Fig. S9. Specific and areal capacitance of 10DPA-CN versus scan rate (a) and versus current density (b).

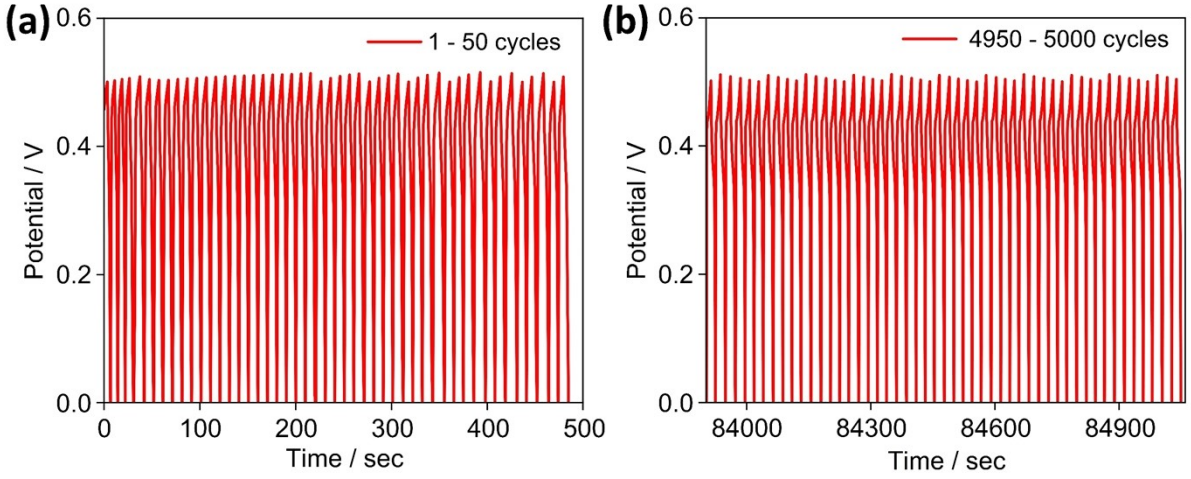


Fig. S10. charge-discharge cycles recorded at the (a) first and (b) last 50 cycles recorded for Capacitance retention and coulombic efficiency.

Table S1. The d-spacing obtained from XRD and SAED.

Catalyst	d-Spacing (nm), XRD	d-spacing (nm), HR-TEM
PCN	0.321	0.328
10DPA-CN	0.322	0.331

Table S2. XPS peak parameters of PCN and 10DPA-CN catalysts.

Sample	Peaks (Atomic %)	Deconvoluted peaks	Peak position (eV)	Peak area (eps.eV)	Peak area (%)
PCN	**C 1s (30.93%)**	C-C/C=C	284.9	8351.3	4.58
		$C\text{-}NH_x$	286.4	3239.0	1.77
		N=C-N	288.5	170620.1	93.63
	N 1S (67.03 %)	C-N=C	398.8	287616.7	72.85
		$N\text{-}(C)_3$	400.1	76114.9	19.27
		$C\text{-}NH_x$	401.3	31066.0	7.86
	O 1s (2.02 %)	-OH	532.5	11942.4	100
10DPA-CN	**C 1s (27.48 %)**	C-C/C=C	284.9	16384.5	11.38
		$C\text{-}NH_x$	286.4	16076.1	11.17
		N=C-N	288.4	102997.4	71.58
		N-C=O	289.5	8428.6	5.85
	N 1s (49.64 %)	C-N=C	399	128955.4	49.61
		$N\text{-}(C)_3$	399.8	105988.2	40.77
		$C\text{-}NH_x$	401.6	24980.1	9.61
	O 1s (22.86 %)	-OH	532.1	86274.5	72.06
		N-C=O	533.4	33459.6	27.94

Table S3. Comparison of photocatalytic activity of 10DPA-CN with reported photocatalysts for degradations of AV7 dye.

Sr. No.	Compos-ition	Light source	AV7 (mg/L)	Amount of catalyst (mg/ L)	Irradiation time (min)	% Degra-dation	Ref.
1.	ZnS-SnO_2	CFL bulbs (12 lamps, 100 W each)	20	2800	60	94.71	[1]
2.	Mg_2SiO_4	Visible light	20	250	150	80	[2]
3.	Eu doped ZnS-Nb_2O_5	CFL bulbs (12 lamps, 100 W each)	20	2800	120	97.88	[3]
4.	ZnO/PPy	15 W LED	5	200	360	64	[4]
5.	ZnS/ $NiFe_2O_4$	CFL bulbs (12 lamps, 100 W each)	20	2916	60	~99	[5]
6.	Pr_6O_{11}/ g-C_3N_4	CFL bulbs (12, 100 W each)	20	1000	20	82.7	[6]
7.	g-C_3N_4/ Fe-TDA	CFL bulbs (12 lamps, 100 W each)	20	1000	50	~98	[7]
8.	Urea-derived g-C_3N_4	CFL bulbs (12 lamps, 100 W each)	20 (lower concen-tration)	1000	30	100	[8]
9.	White g-C_3N_4/ g-C_3N_4	CFL bulbs (12 lamps, 100 W each)	20 (lower concen-tration)	1000	50	~98	[9]
10.	Ag/AgO/ g-CN microsp-heres	CFL bulbs (12 lamps, 100 W each)	20 (lower concen-tration)	1000	30	98	[10]
11.	**10DPA-**	**CFL bulbs**	**50**	**1000**	**80**	**93.7**	**This**

	CN	**(10 lamps, 85 W each)**	**(higher conc.)**				**work***

References:

1. S. G. Ghugal, D. Vidyasagar, K. K. Tadi, Geethukrishnan, S. S. Umare, Y. Jeong and J. Yoon, *Materials Science in Semiconductor Processing*, 2023, **165**, 107657.
2. S. Moshtaghi, M. Hamadanian, O. Amiri, M. Goli and M. Salavati-Niasari, *RSC Advances*, 2021, **11**, 21588-21599.
3. S. G. Ghugal, P. Ramteke, K. Kumar Tadi, S. Sarkar, S. Mary Gali, S. S. Umare, W. Lee, Y. Jeong and J. Yoon, *Journal of Photochemistry and Photobiology A: Chemistry*, 2024, **453**, 115588.
4. D. A. González-Casamachin, J. Rivera De la Rosa, C. J. Lucio-Ortiz, D. A. De Haro De Rio, D. X. Martínez-Vargas, G. A. Flores-Escamilla, N. E. Dávila Guzman, V. M. Ovando-Medina and E. Moctezuma-Velazquez, *Chemical Engineering Journal*, 2019, **373**, 325-337.
5. A. G. Shende, S. G. Ghugal, D. Vidyasagar, S. S. Umare, S. B. Kokane and R. Sasikala, *Materials Chemistry and Physics*, 2019, **221**, 483-492.
6. A. G. Shende, S. G. Ghugal, D. Vidyasagar, S. B. Kokane, Jagannath, S. S. Umare and R. Sasikala, *Materials Research Bulletin*, 2018, **107**, 154-163.
7. D. Vidyasagar, A. Kulkarni, S. G. Ghugal and S. S. Umare, *Journal of Chemical Technology & Biotechnology*, 2019, **94**, 761-767.
8. V. Devthade, D. Kulhari and S. S. Umare, *Materials Today: Proceedings*, 2018, **5**, 9203-9210.
9. D. Vidyasagar, A. Gupta, A. Balapure, S. G. Ghugal, A. G. Shende and S. S. Umare, *Journal of Photochemistry and Photobiology A: Chemistry*, 2019, **370**, 117-126.
10. D. Vidyasagar, S. G. Ghugal, A. Kulkarni, P. Mishra, A. G. Shende, Jagannath, S. S. Umare and R. Sasikala, *Applied Catalysis B: Environmental*, 2018, **221**, 339-348.