Electronic Supplementary Information

Photocatalytic valorization of furfural to value-added chemicals via mesoporous carbon nitride: A possibility through metal-free pathway

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1. Characterization of SGCN

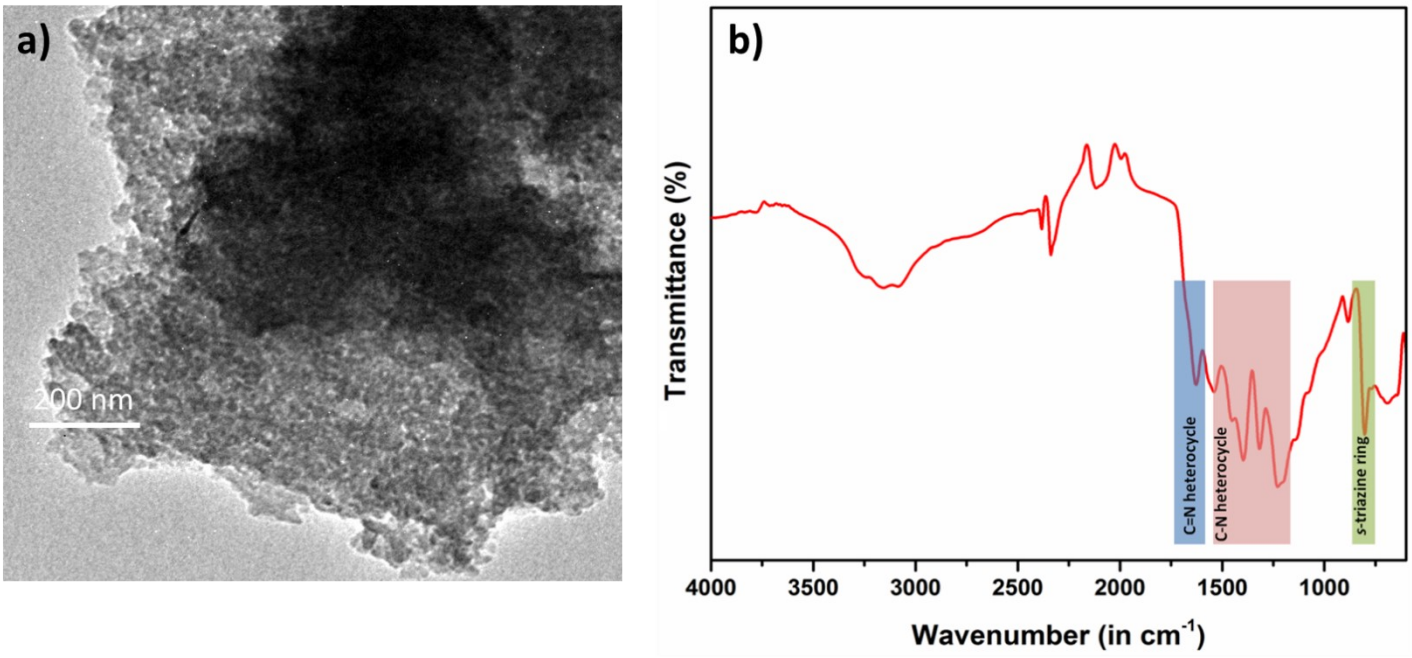

Figure S1. a) TEM image of SGCN, and b) FT-IR spectra of SGCN.

Table S1 Chemical composition of SGCN.

Entry	Catalyst	C atomic %	N atomic %	O atomic %
1	SGCN	58.30	40.75	0.95
2	SGCN After 4th cycle	55.54	42.37	2.10

2. Experimental analysis

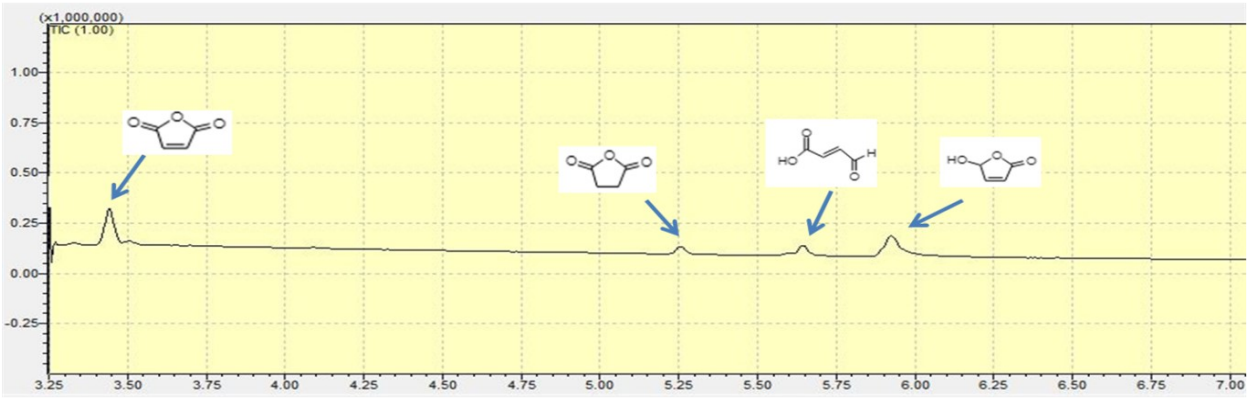

Figure S2. GC-MS graph of FUR photo-oxidation after 30 h.

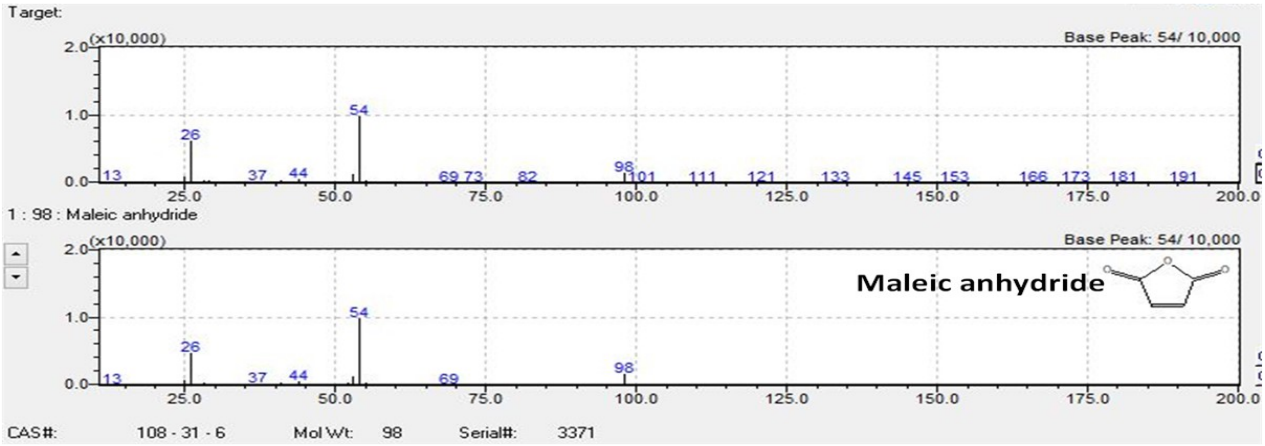

Figure S3. MS graph of maleic anhydride from photo catalytic FUR oxidation by SGCN.

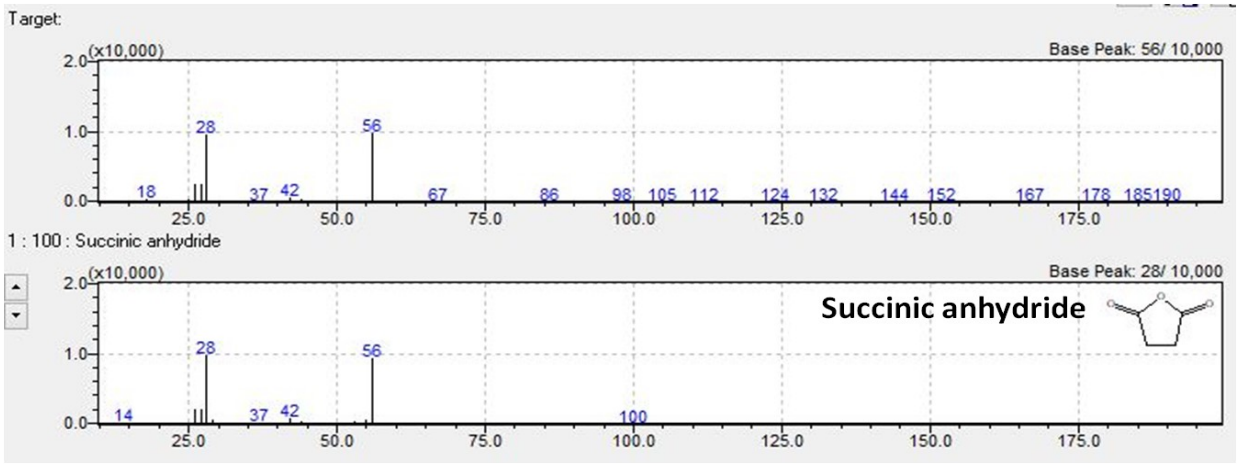

Figure S4. MS graph of succinic anhydride from photo catalytic FUR oxidation by SGCN.

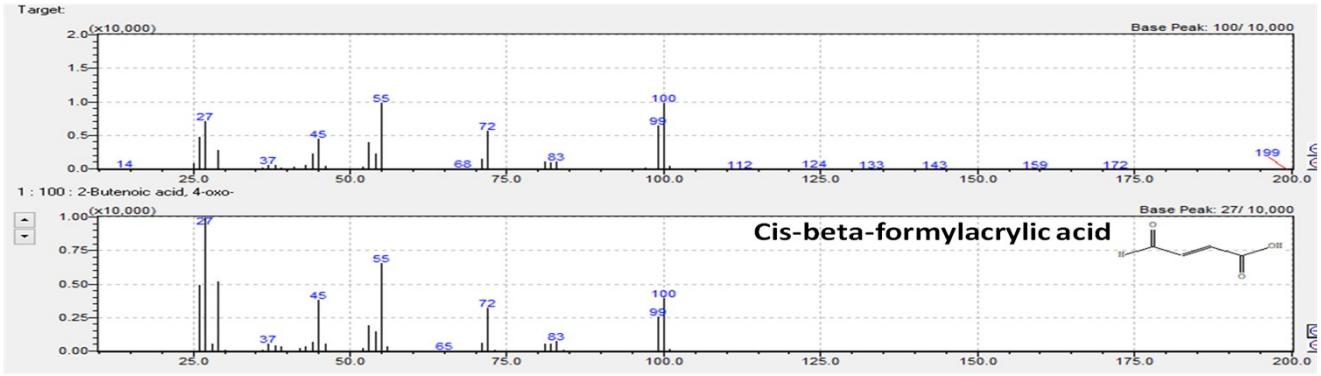

Figure S5. MS graph of cis-beta-formylacrylic acid from photocatalytic FUR oxidation by SGCN.

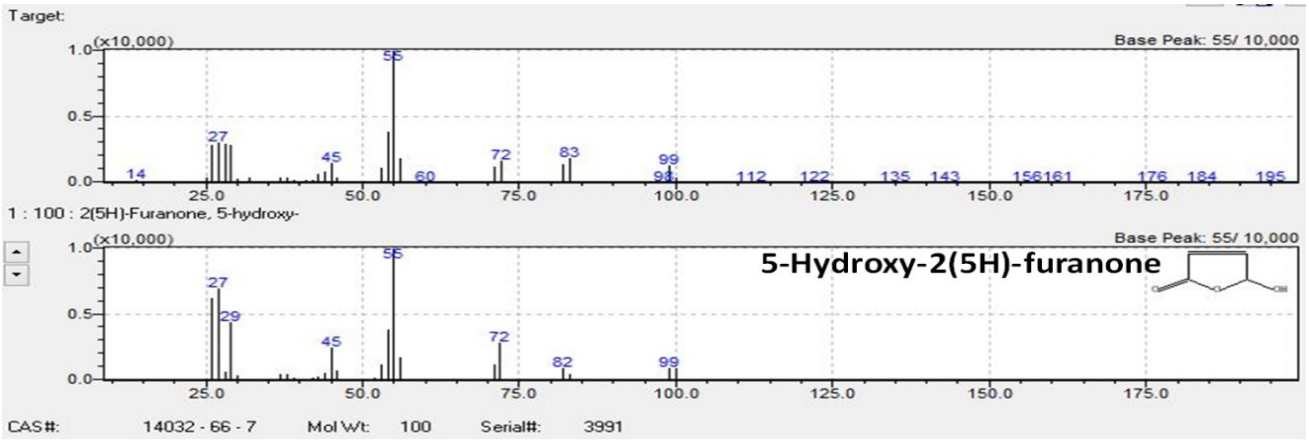

Figure S6. MS graph of 5-hydroxy-2(5H)-furanone from photo catalytic FUR oxidation by SGCN.

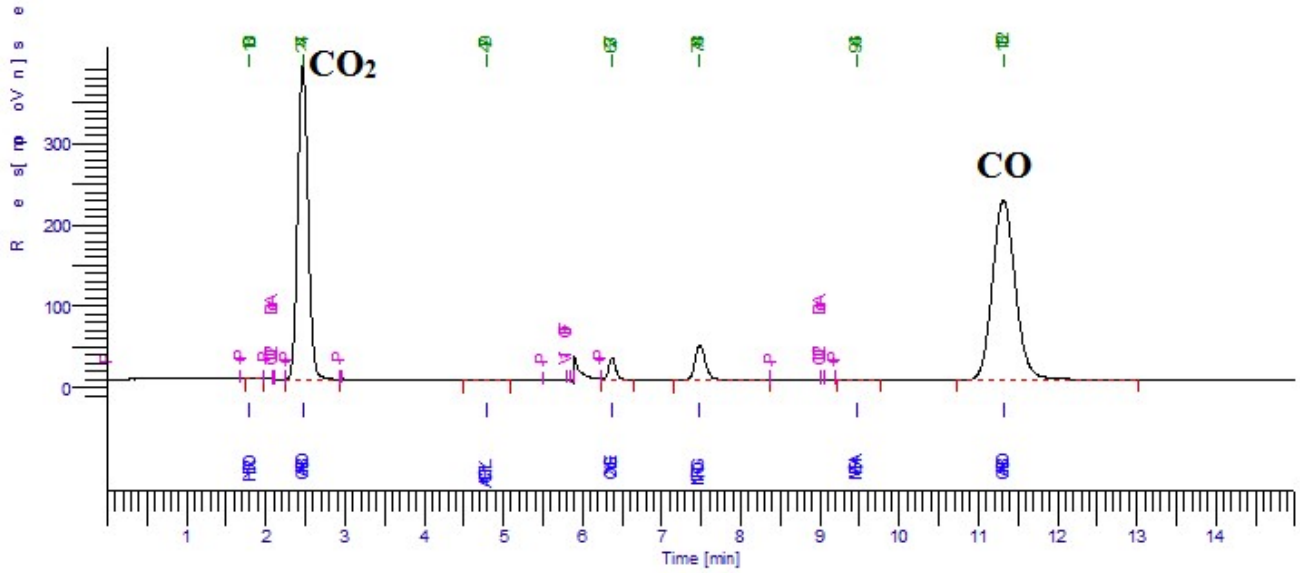

Figure S7. GC profile showing concentration of gaseous CO_x after FUR photo-oxidation by SGCN.

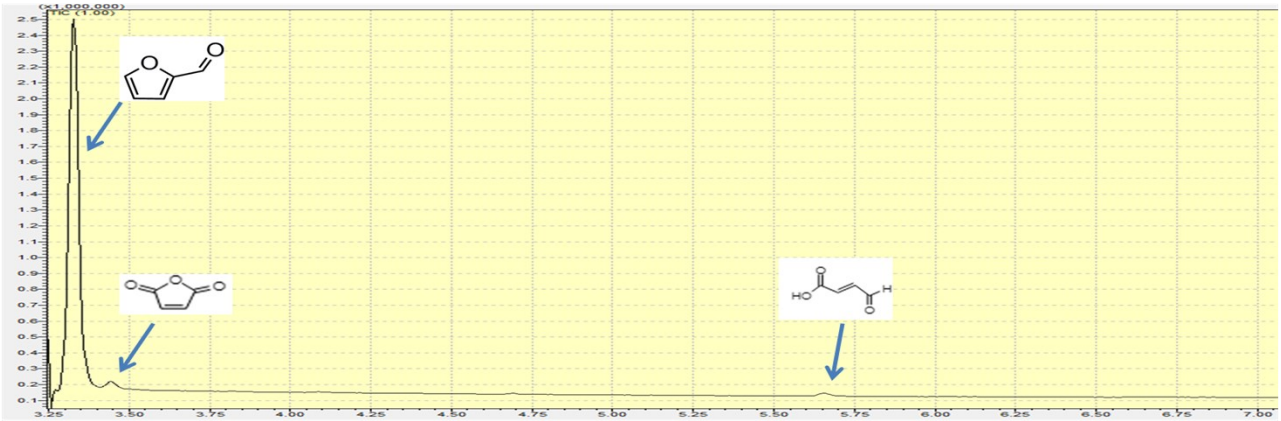

Figure S8. GC-MS chromatogram of FUR photo-oxidation under natural sunlight by SGCN after 8 h.

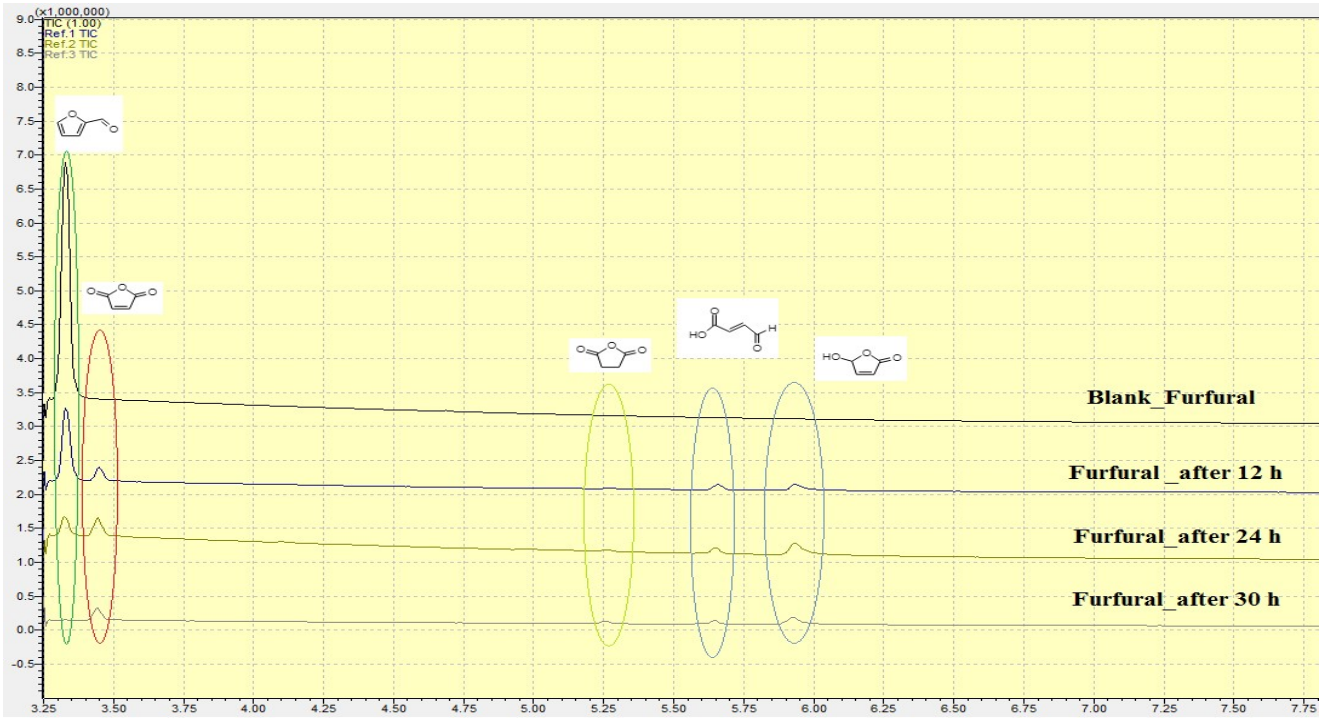

Figure S9. GC-MS chromatogram of FUR and reaction mixture at 12, 24 and 30 h.

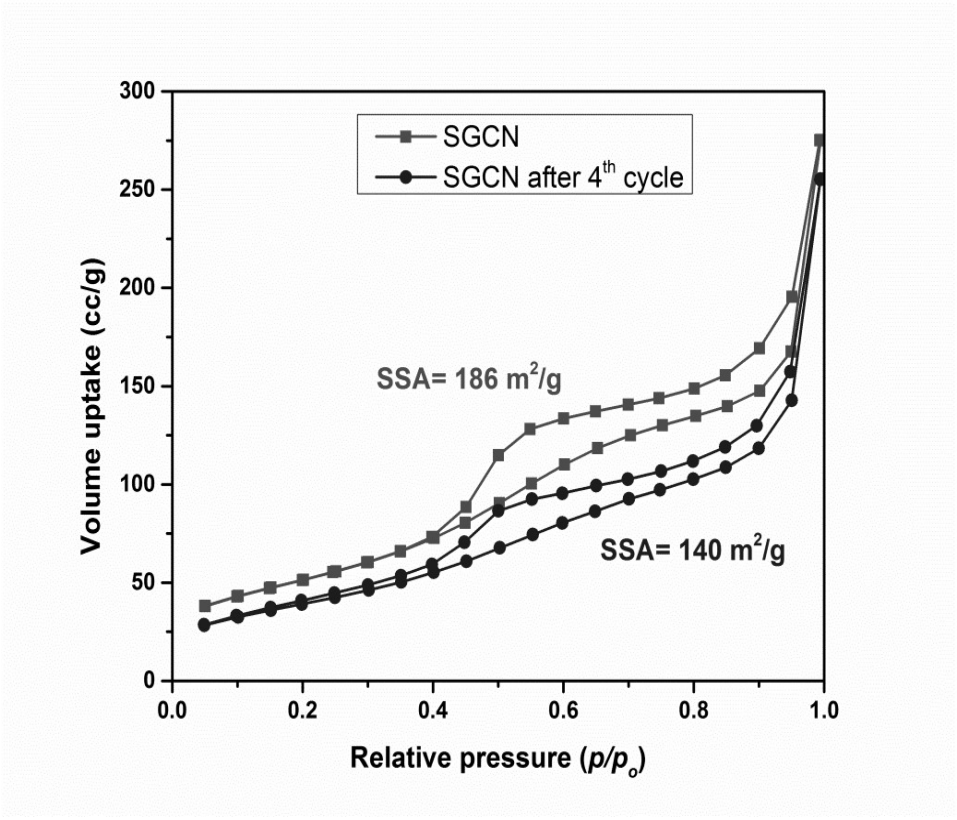

Figure S10. N_2 physisorption isotherm of SGCN and recyclability tests of SGCN after 4 cycles.

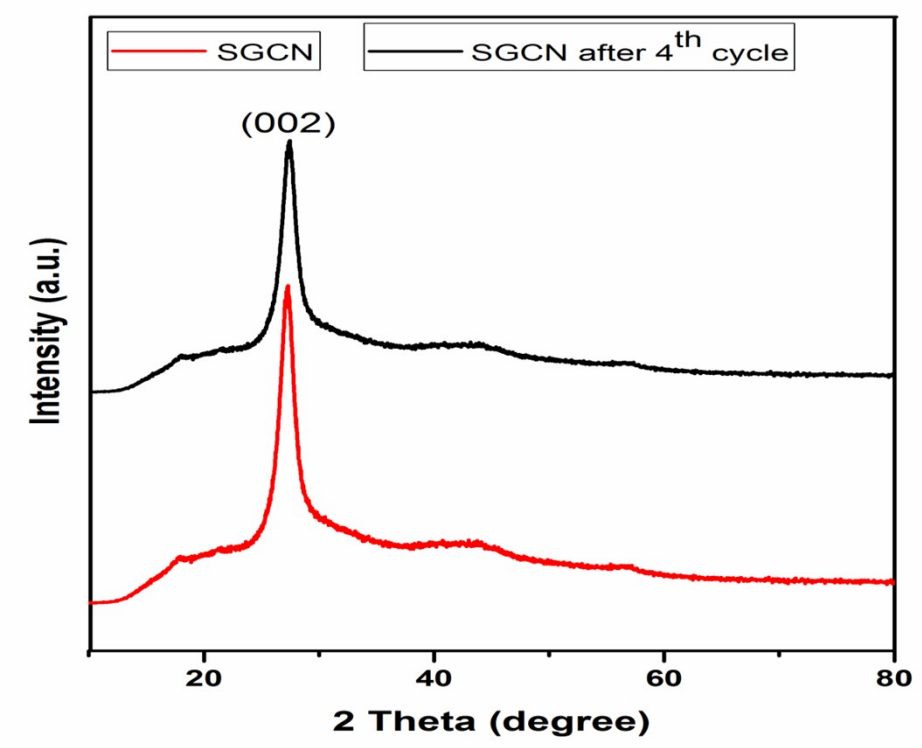

Figure S11. XRD pattern of SGCN and SGCN after recyclability tests for 4 cycles.

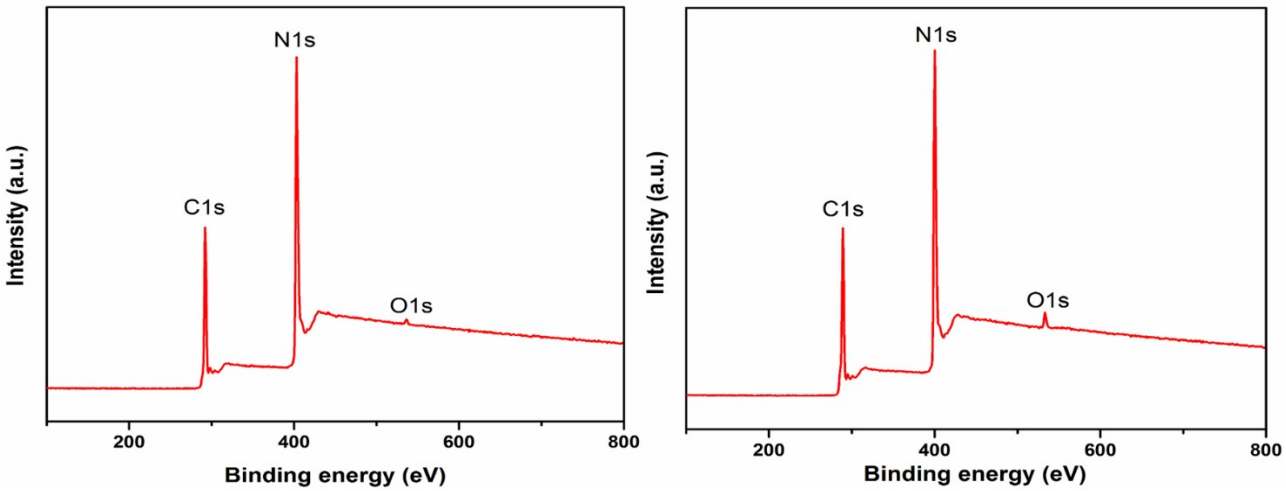

Figure S12 a) XPS survey scan of SGCN and b) XPS survey scan of SGCN after 4th cycle.

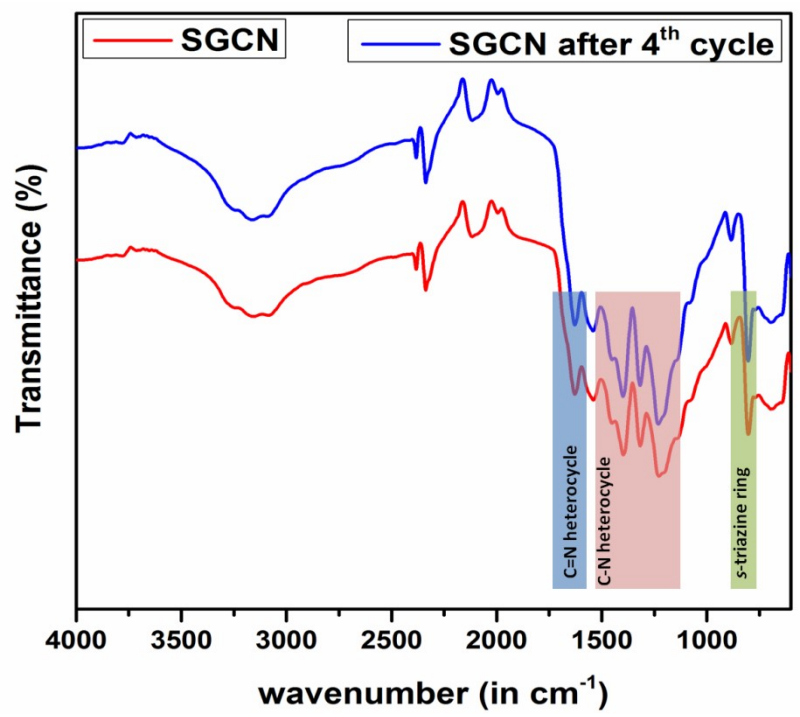

Figure S13 FT-IR spectra of SGCN before and after 4th cycle.

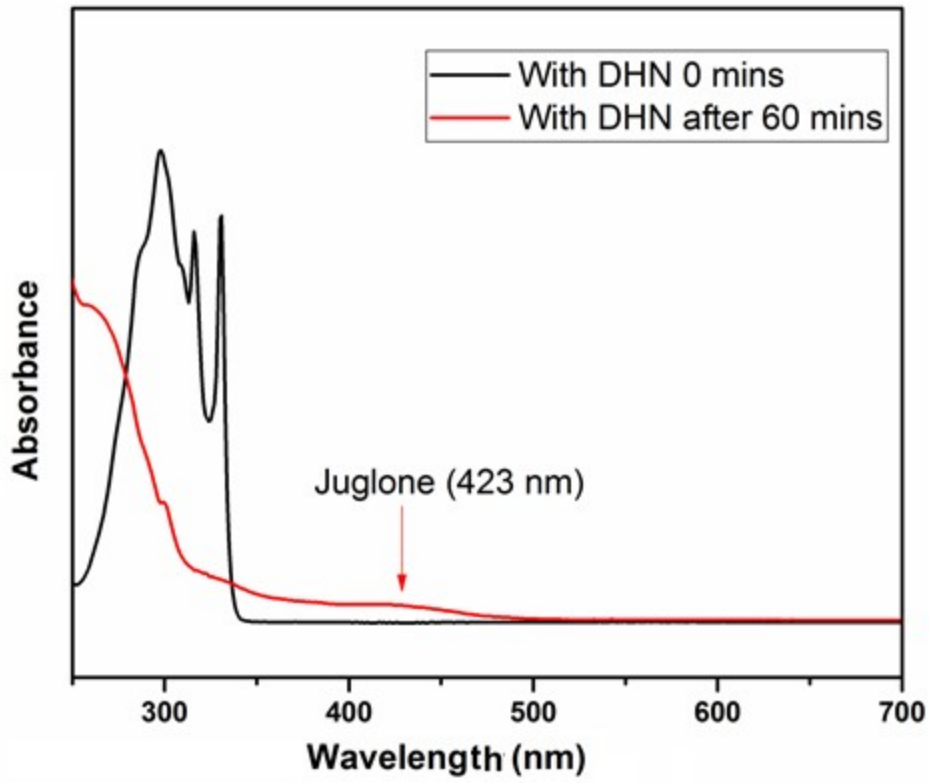

Figure S14. UV–Vis spectra of DHN in presence of SGCN.

The DPD control experiment:

Initially, the DPD was added to the reaction mixture (0.11 mmol, 5 ml ACN) in the presence of SGCN and kept for magnetic stirring under visible light irradiation (> 420 nm). As the reaction proceeds, no change in the spectra was observed. In other words, no absorption was seen in the range of 400-500 nm which is the characteristic peak for DPD radical cation formed by the DPD oxidation in presence of H_2O_2. Thus, this confirmed that there was no H_2O_2 generation during the reaction.

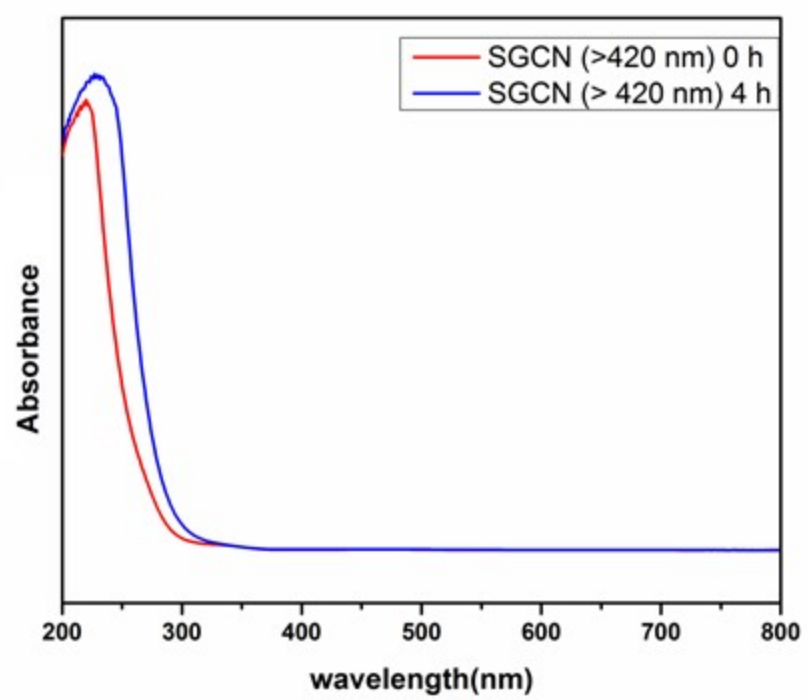

Figure S15. UV-Vis absorption spectra of the reaction mixture (Furfural, 5ml ACN) with SGCN in the presence of visible light Xe lamp (> 420 nm) after adding N, N-diethyl-1,4-phenylenediamine (DPD).

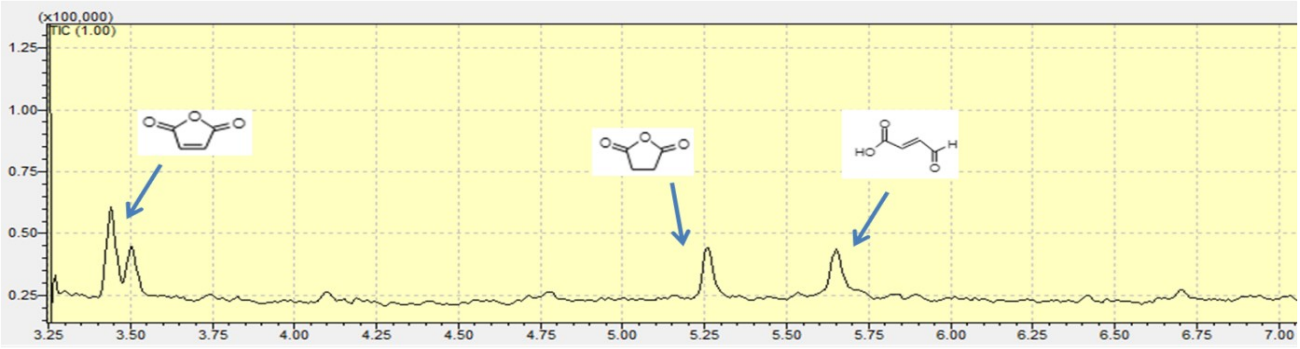

Figure S16. GC-MS chromatogram of furoic acid photo-oxidation by SGCN.

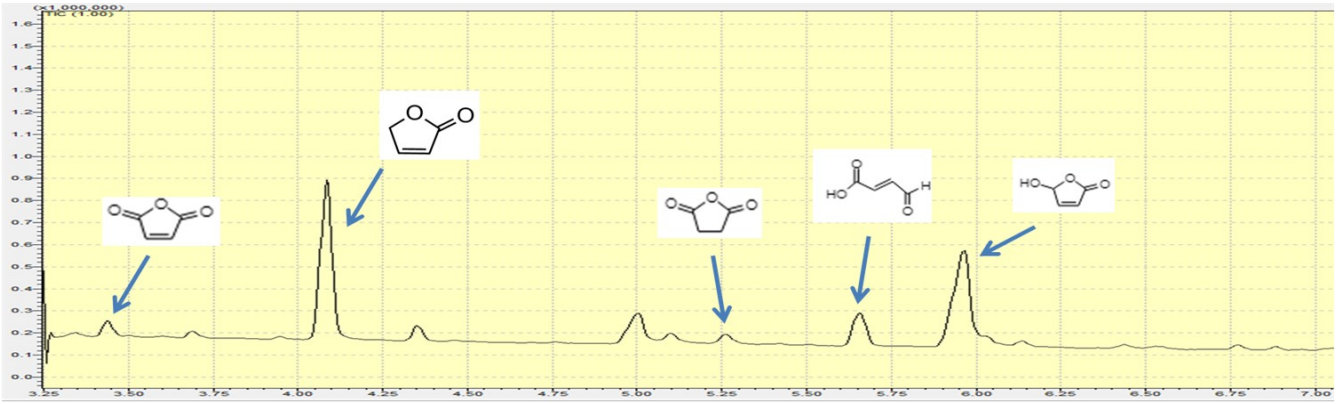

Figure S17. GC-MS chromatogram of furan photo-oxidation by SGCN.

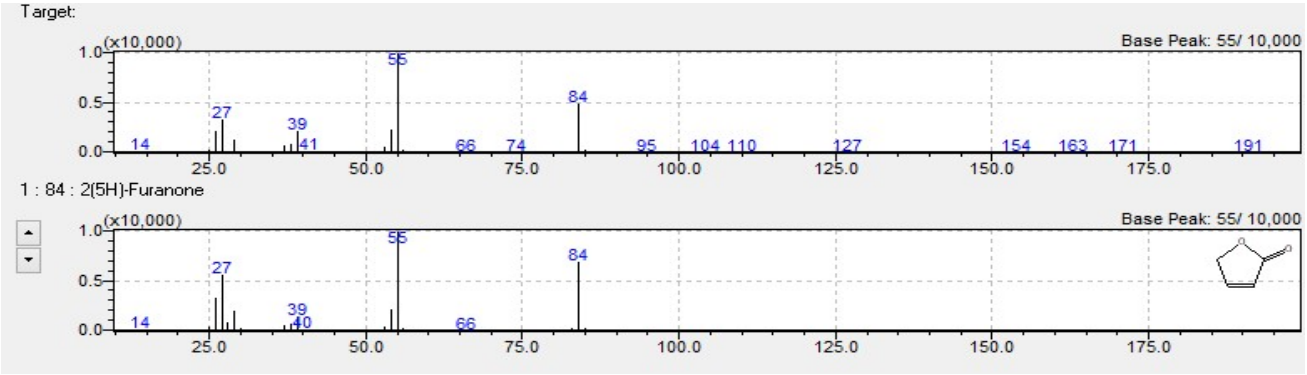

Figure S18. MS graph of 2(5H)-furanone from photocatalytic furan oxidation by SGCN.

3. Comparative table of FUR oxidation.

Table S2: FUR oxidation into maleic anhydride, furanone derivatives and acids - a comparative study.

S. No.	Catalyst	Conditions	Conv. (%)	Products (selectivity %)	Reference
1.	VO–NH_2-GO	**Thermal** Acetic acid 10.0 mL, 90 ^oC, O_2 20 bar and 8h	82.1 %	Maleic anhydride (N.A.)	[1]
2.	VPO	**Thermal** Gas phase, 10% O_2, 340 ^oC and 12h.	>99 %	Maleic anhydride (97)	[2]
3.	$H_5PV_2Mo_{10}O_{40}$ and Cu $(CF_3SO_3)_2$	**Thermal** O_2 (20 atm), acetonitrile–	93.8 %	Maleic anhydride (N.A.) and 5-acetoxyl-2(5H)-furanone(N.A.)	[3]

		acetic acid (2:1.3, v/v), 110 ^{o}C and 14h.			
4.	Mo_4VO_{14}	**Thermal** acetic acid, 10 ml, O_2 20 bar, 120 °C and 16 h.	100 %	Maleic anhydride (65)	[4]
5.	Mg $(OH)_2$	**Thermal** 0.1 mol H_2O_2, 70 °C and 1h.	100 %	2(5H)-furanone (44.8) and succinic acid (38)	[5]
6.	VOx/Al_2O_3	**Thermal** Gas phase, O_2 and 320 ^{o}C	100 %	Maleic anhydride (73)	[6]
7.	VON-GO	**Thermal** acetic acid, 10.0 mL, 90 ^{o}C; O_2 20 bar	59.9 %	Maleic anhydride (N.A.)	[7]
8.	Au	**Electro-oxidation**	-	Furoic acid (N.A.)	[8]
9.	PbO_2, MnO_2 and Pt	**Electro-chemical oxidation**	100 %	Maleic acid (N.A.)	[9]
10.	CuS/CP	**Electro-chemical oxidation**	70.2 %	5-hydroxy-2(5H)-Furanone (83.6)	[10]
11.*	Rose Bengal dye (homogeneous photocatalyst)	**Photocatalytic oxidation** EtOH/H_2O	-	5-hydroxy-2(5H)-Furanone (N.A.)	[11]
12.	SGCN (heterogeneous photocatalyst)	**Photocatalytic oxidation Simulated solar light (AM 1.5G)** ACN, O_2 and 30h.	> 95 %	Maleic anhydride (42) and 5-hydroxy-2(5H)-Furanone (33)	This work

N.A= Not available

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