Supporting Information

Temperature dependent, shape variant synthesis of photoluminescent and biocompatible carbon nanostructures from almond husk for applications in dye removal

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Characterization techniques

Scanning electron microscopic imaging were done by using field-emission scanning electron microscopy (FESEM) SUPRA 40VP, Carl Zeiss (NTS GmbH, Oberkochen, Germany) microscope operated at 10 kV in high vacuum mode. Samples for SEM analyses were prepared by ultrasonication of wsFCNSs (5 mg) in water (10 mL) for 10 minute then 100 µL solution was drop casted on a brass stub, and finally dried for 2 h under a 100 W tungsten lamp. The TEM analysis was carried out at an accelerating voltage of 200 kV with a Tecnai 20 G2 STWIN model. 5µL aqueous solution was drop casted onto a holey carbon coated copper grid having mesh size of 400 and dried for 2 h under a 100 W tungsten lamp. The fluorescence microscopic images of wsFCNSs were analyzed on a Leica inverted microscope (Leica DC200, microscopy system Ltd., CH-9435, Heerbrugg).

FTIR spectra of samples were analyzed with Perkin Elmer spectrometer using globular lamp source with KBr beam splitter and DTGS/KBr detector. Spectra were collected in solid state with pressed pellets in the range of 400-4000 cm^{-1} with 4 cm^{-1} resolution. Raman spectra were recorded on a WITEC model Raman spectrometer with Ar^{+} laser (λ_e =

532 nm). The thermo gravimetric analyses were carried out by using a C. I. electronics analyzer on a SDTQ 600, TA instruments, (waters LLC, 159 Lukens Drive, New Castle DE 19720) in inert atmosphere at 10 ˚C/min heating rate. UV-Vis spectra of wsFCNSs in water were performed by Double beam UV-Visible spectrometer (Varian Cary 100, Germany). The PL spectra of aqueous solutions were recorded with Perkin Elmer LS55 fluorescence spectrometer with tunable excitation wavelength in the range of 400-620 nm at room temperature. Zeta potential measurements for the detection of surfacial charges were carried out with a Malvern Zetasizer Nano ZS 90 in aqueous solution.

Lysis of erythrocytes was determined by UV-Vis at 540 nm absorbance. Maximum absorption of UV light occurs at 319 nm for PNP absorption. BET surface area and total pore volume was analyzed by using Quantachrome Autosorb, USA at 77.30 K by nitrogen adsorption.

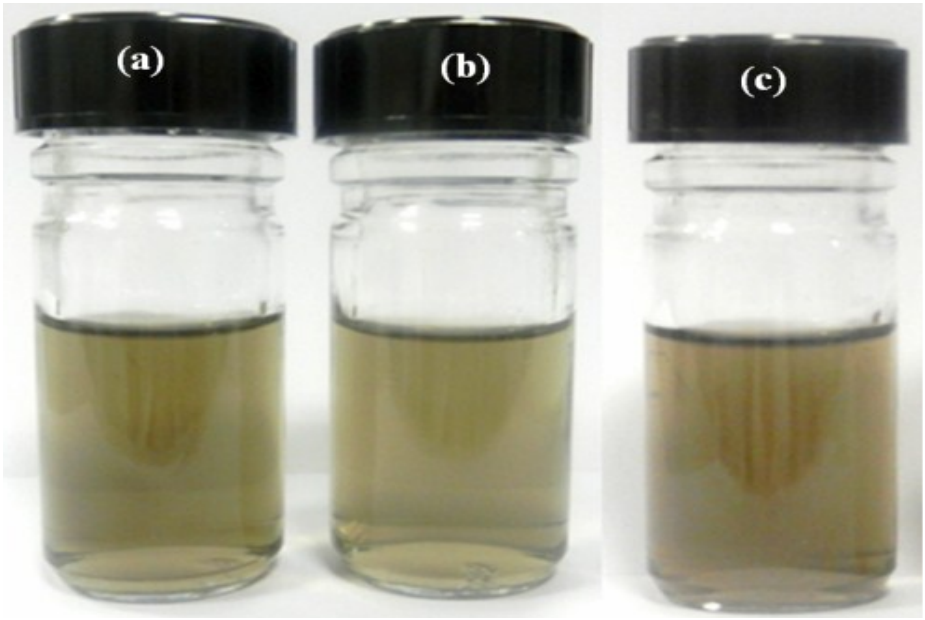

Fig. S1. Digital images showing the water solubility of wsFCNS (1 mg/ mL); **(a)** wsCNR, **(b)** wsCNP and **(c)** wsCND.

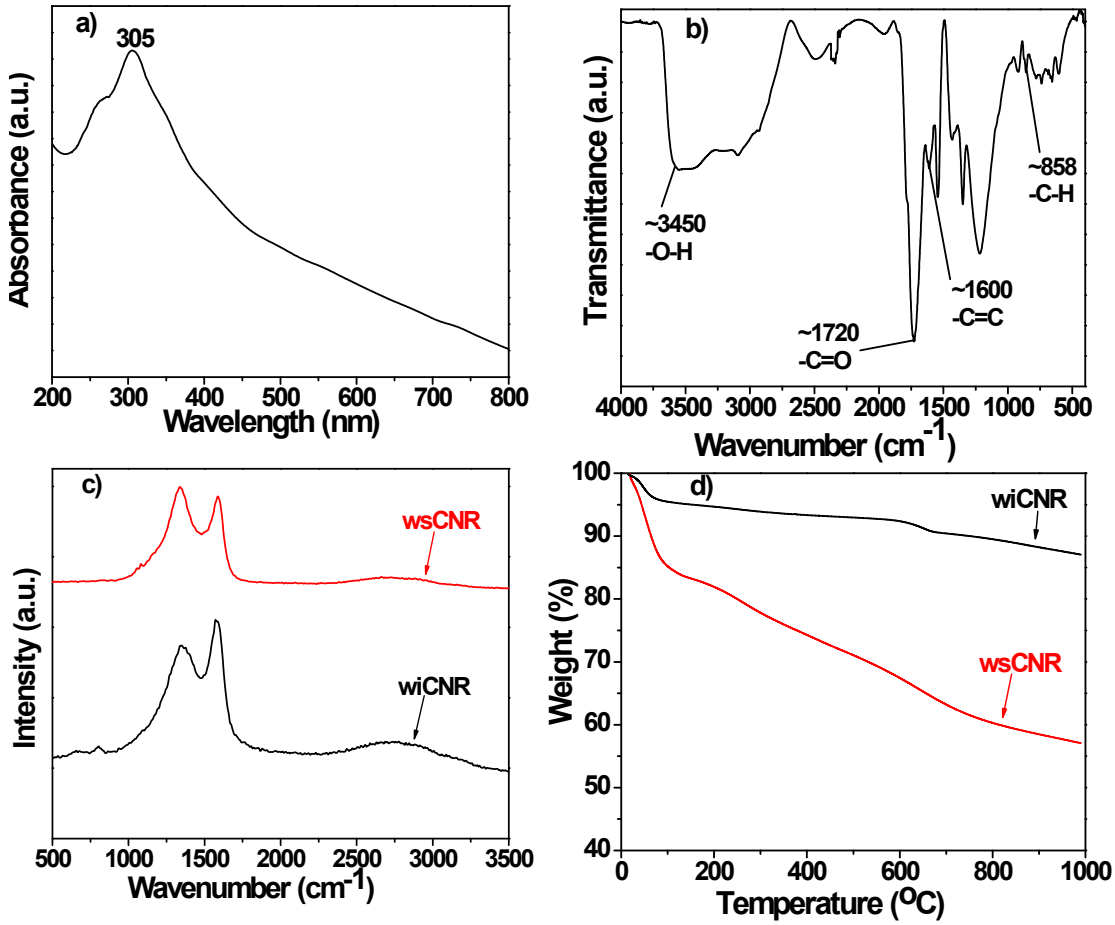

Fig. S2: (a) UV-Visible absorption spectrum of aqueous solution of wsCNR; **(b)** FTIR spectra of wsCNR at room temperature; **(c)** Raman spectra and **(d)** TGA analysis curves of wsCNRs and wiCNR.

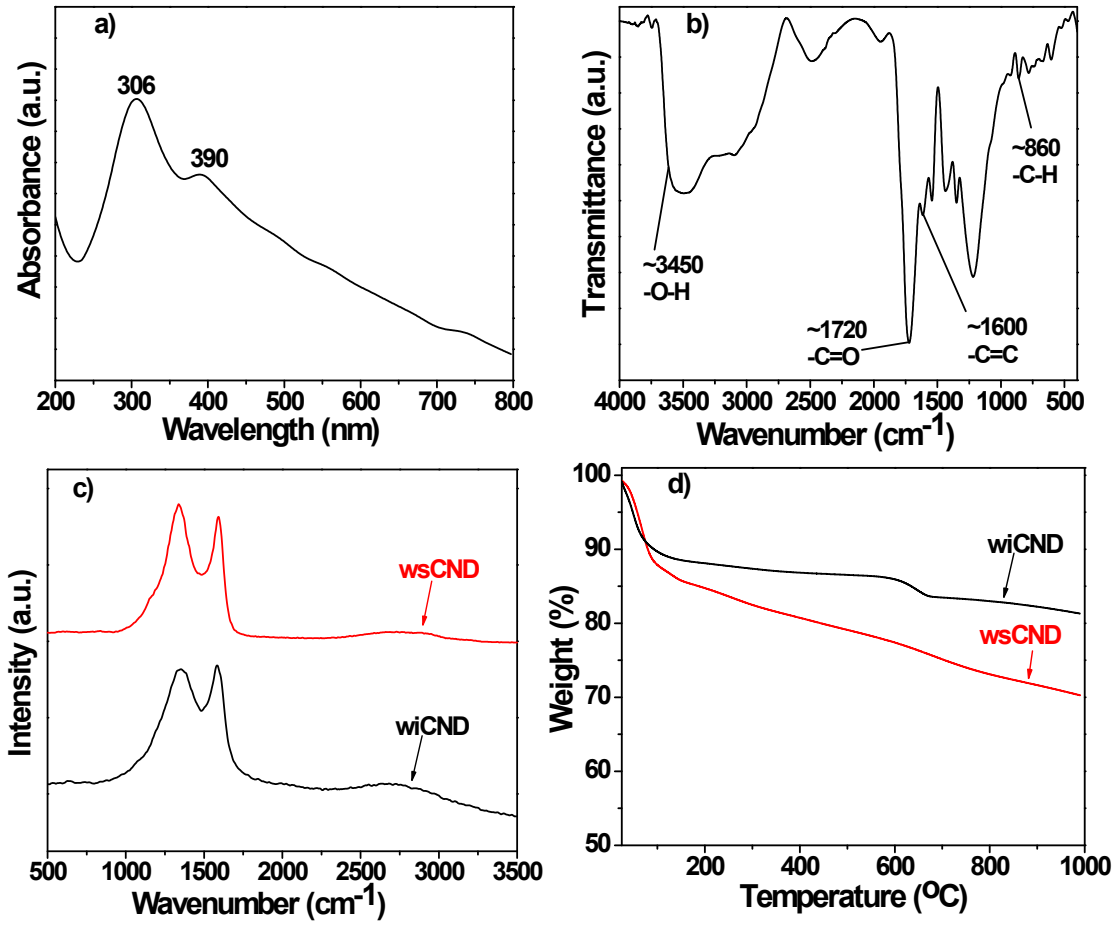

Fig. S3: (a) UV-Visible absorption spectrum of aqueous solution of wsCND; **(b)** FTIR spectra of wsCND at room temperature; **(c)** Raman spectra and **(d)** TGA analysis curves of wsCNDs and wiCND.

Table S1: Best fit frequencies of the D and G bands for carbon nanorods, carbon nanoparticles and carbon nanodots before and after oxidative treatment obtained at 532 nm excitation wavelength and their corresponding approximated average crystallite size L_a.

Sample	νD [cm^{-1}]	νG [cm^{-1}]	I_G/I_D	L_a [nm]
wiCNR	1345	1581	0.70	13.45
wsCNR	1338	1587	0.55	10.57
wiCNP	1344	1598	0.64	12.30
wsCNP	1340	1589	0.52	9.99
wiCND	1348	1583	0.62	11.91
wsCND	1336	1589	0.49	9.42

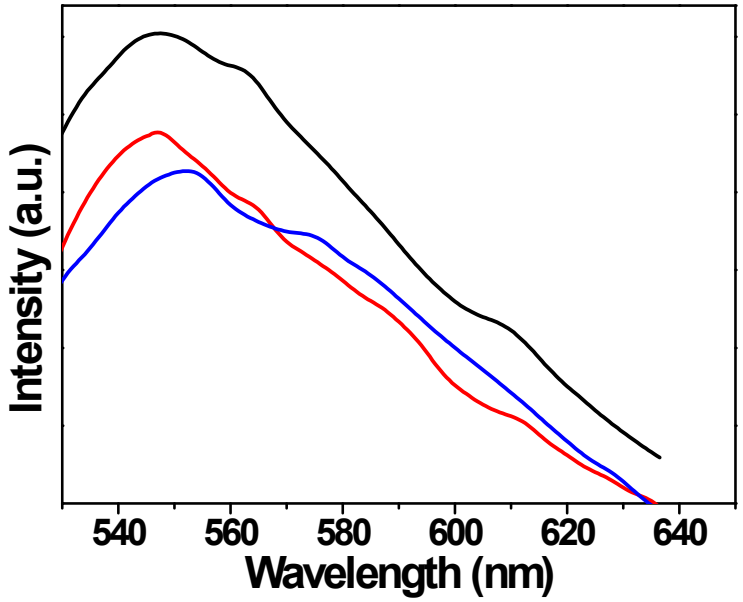

Fig. S4: Comparative PL intensity of wsCND (black), wsCNP (red) and wsCNR (blue) at 400 nm excitation wavelength.

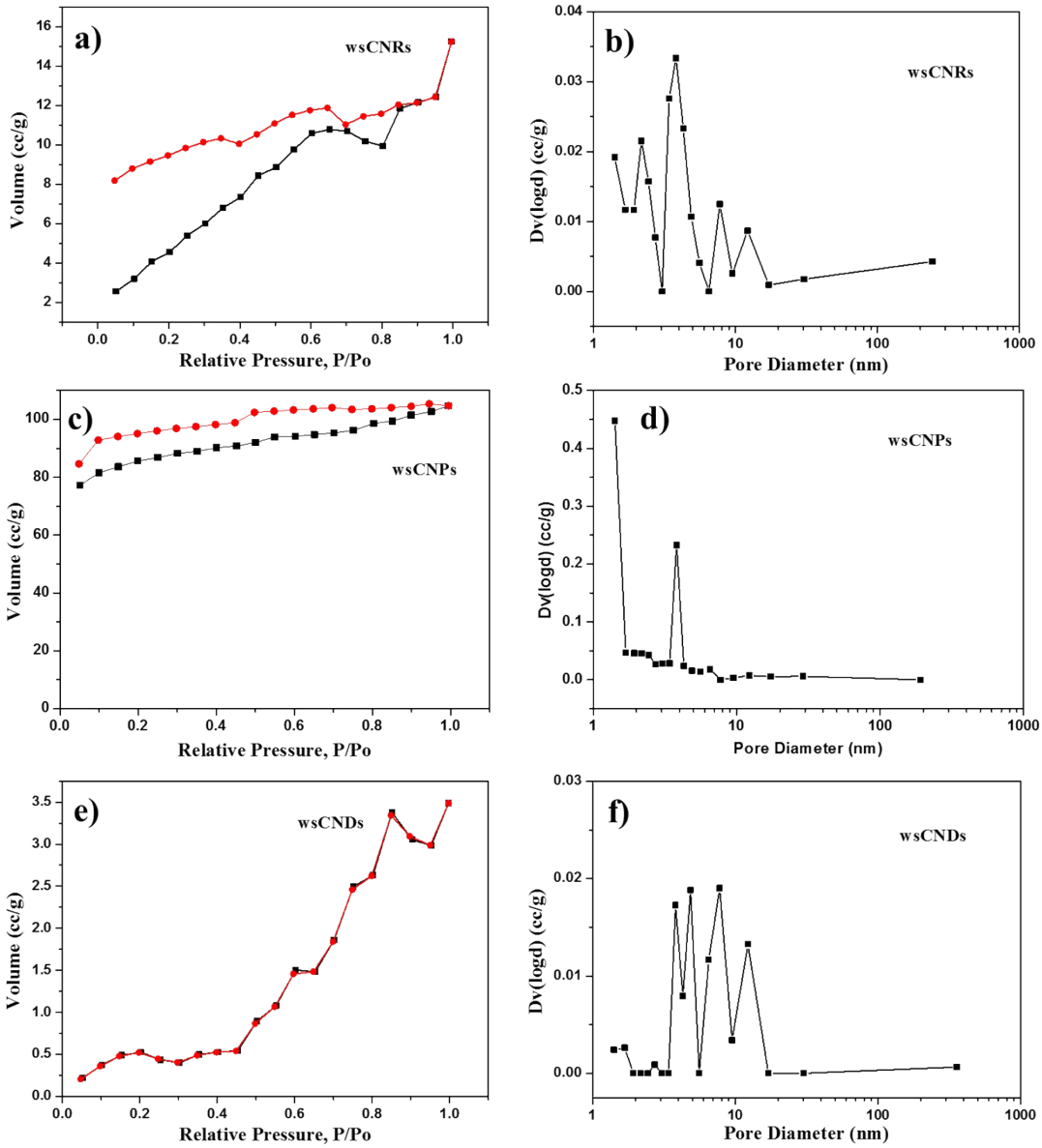

Fig. S5: Adsorption (black dots) – desorption (red points) curves for the wsFCNS; **(a)** wsCNR; **(c)** wsCNP and **(e)** wsCND, corresponding pore size distribution curves for the wsFCNS; **(b)** wsCNR; **(d)** wsCNP and **(f)** wsCND.

Table S2: BET results for the wsCNSs

Sample Name	BET Surface area ($m^2\ g^{-1}$)	Total Pore Volume ($cm^3\ g^{-1}$)	DFT method pore volume ($cm^3\ g^{-1}$)
wsCNRs	20.60	0.0236	0.0186
wsCNPs	265.6	0.1623	0.1460
wsCNDs	1.358	0.0054	0.0052

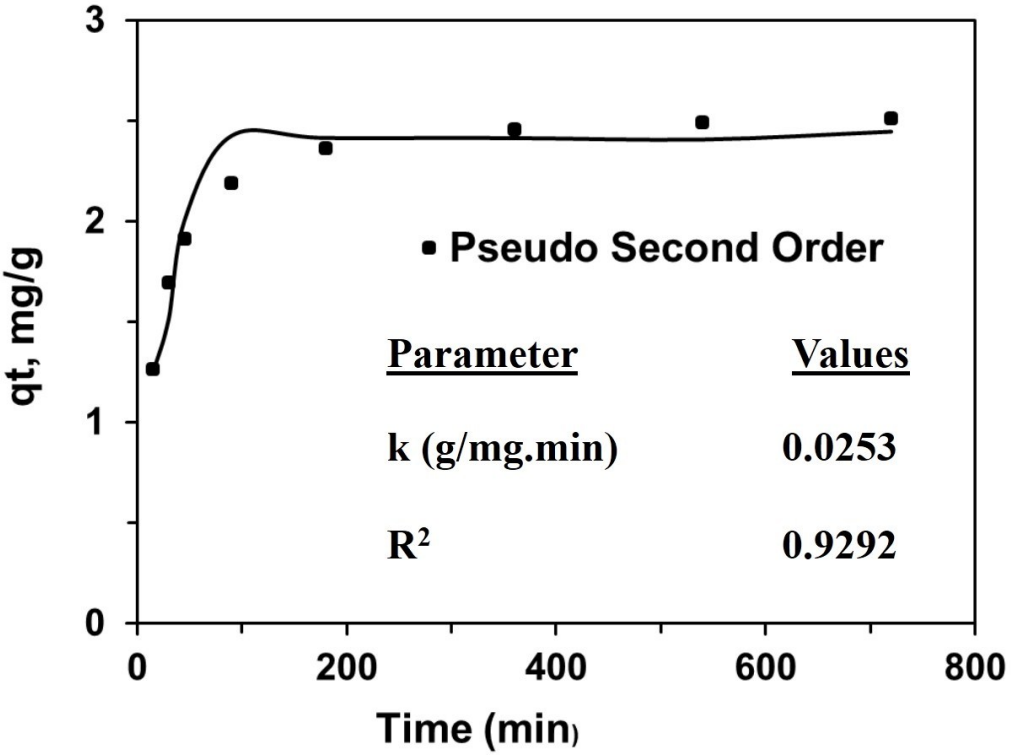

Fig. S6: Pseudo second order kinetic model, experimental data points are given by symbols and line predicted by pseudo second order kinetics.

Calibration: 13.9 mg of PNP was dissolved in 100 mL DI water to prepare the 1000 µmol/L standard solution. This solution was diluted to different concentrations (1 – 55 µmol/L) to prepare the standard solutions. Absorbance was noted at λ_{max} = 319 nm.

Table S3: Absorbance of PNP at different concentrations

Concentration (µmol/L)	Absorbance
1	0.0089
5.5	0.043
10	0.0789
32.5	0.2497
55	0.4452

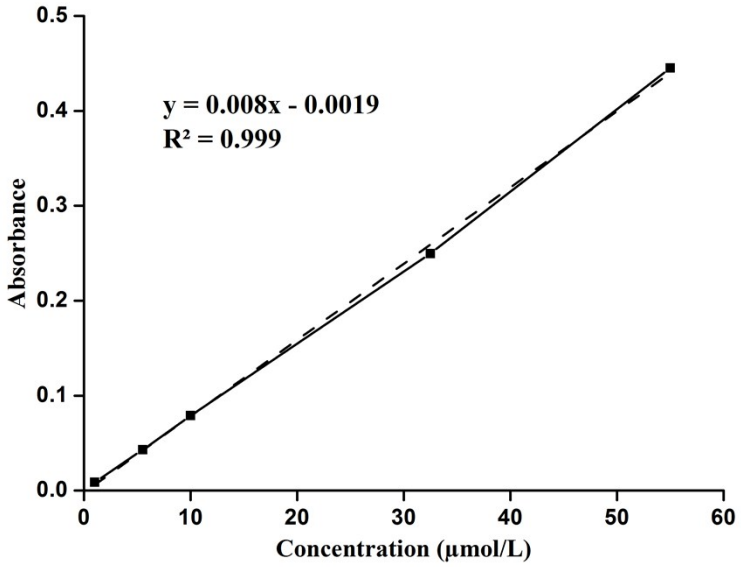

Fig. S7: Calibration curve for the adsorption of PNP