Supporting Information

Polyol asserted hydrothermal synthesis of SnO_2 nanoparticles for fast adsorption and photocatalytic degradation of methylene blue cationic dye

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Table S1 Intensity ratio of (101) and (110) planes in the XRD patterns of polyol functionalised SnO_2 NPs.

Samples	**I_{110}**	**I_{101}**	**I_{101} / I_{110}**
Sn-EG	1087.4	876.60	0.8055
Sn-DEG	2486.8	2001.9	0.8050
Sn-TEG	2147.8	1668.9	0.7770
Sn-PEG4	856.71	720.30	0.8407
Sn-PEG6	916.66	866.50	0.9452

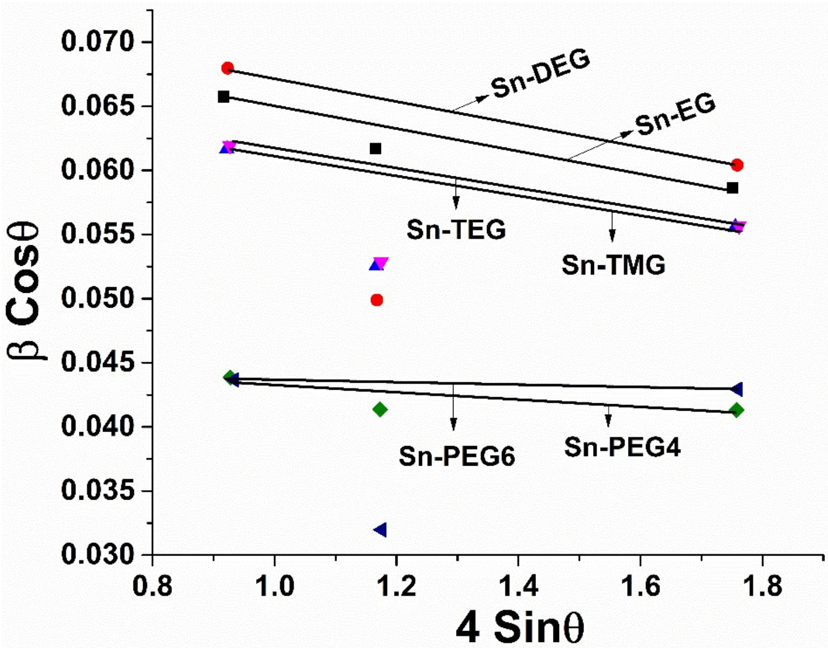

Fig. S1 Williamson-Hall (W-H) plots for different SnO_2 NPs.

Table S2 Comparative crystallite sizes calculated using Debye-Scherrer formula and Williamson-Hall equation.

Samples	XRD size	Williamson-Hall size	Strain factor	Type of strain
Sn-EG	2.239	2.00	-0.2035	compressive
Sn-DEG	2.370	2.06	-0.2169	compressive
Sn-TEG	2.459	2.21	-0.1747	compressive
Sn-PEG4	3.289	3.10	-0.0726	compressive
Sn-PEG6	3.578	3.44	-0.0209	compressive

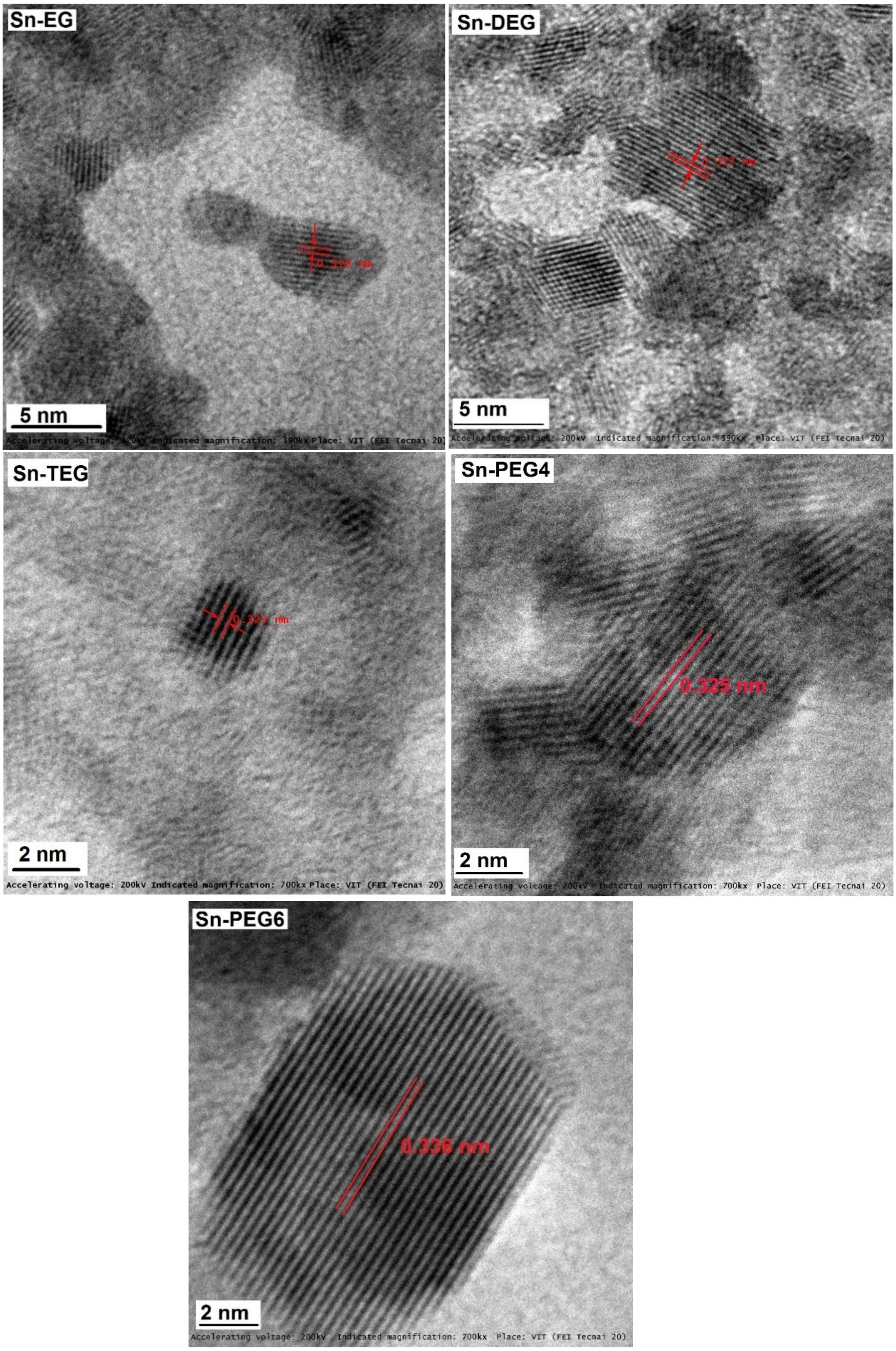

Fig. S2 HRTEM images of different SnO_2 NPs.

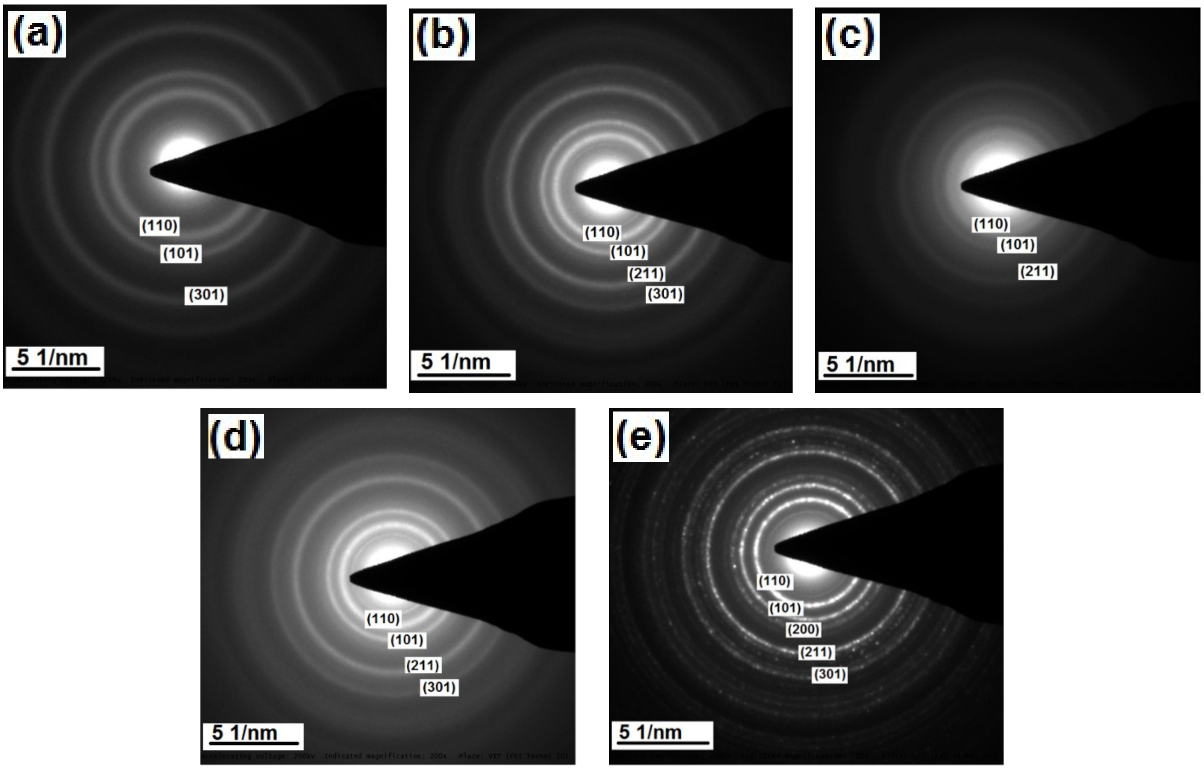

Fig. S3 SAED patterns of (a) Sn-EG, (b) Sn-DEG, (c) Sn-TEG, (d) Sn-PEG4 and (e) Sn-PEG6.

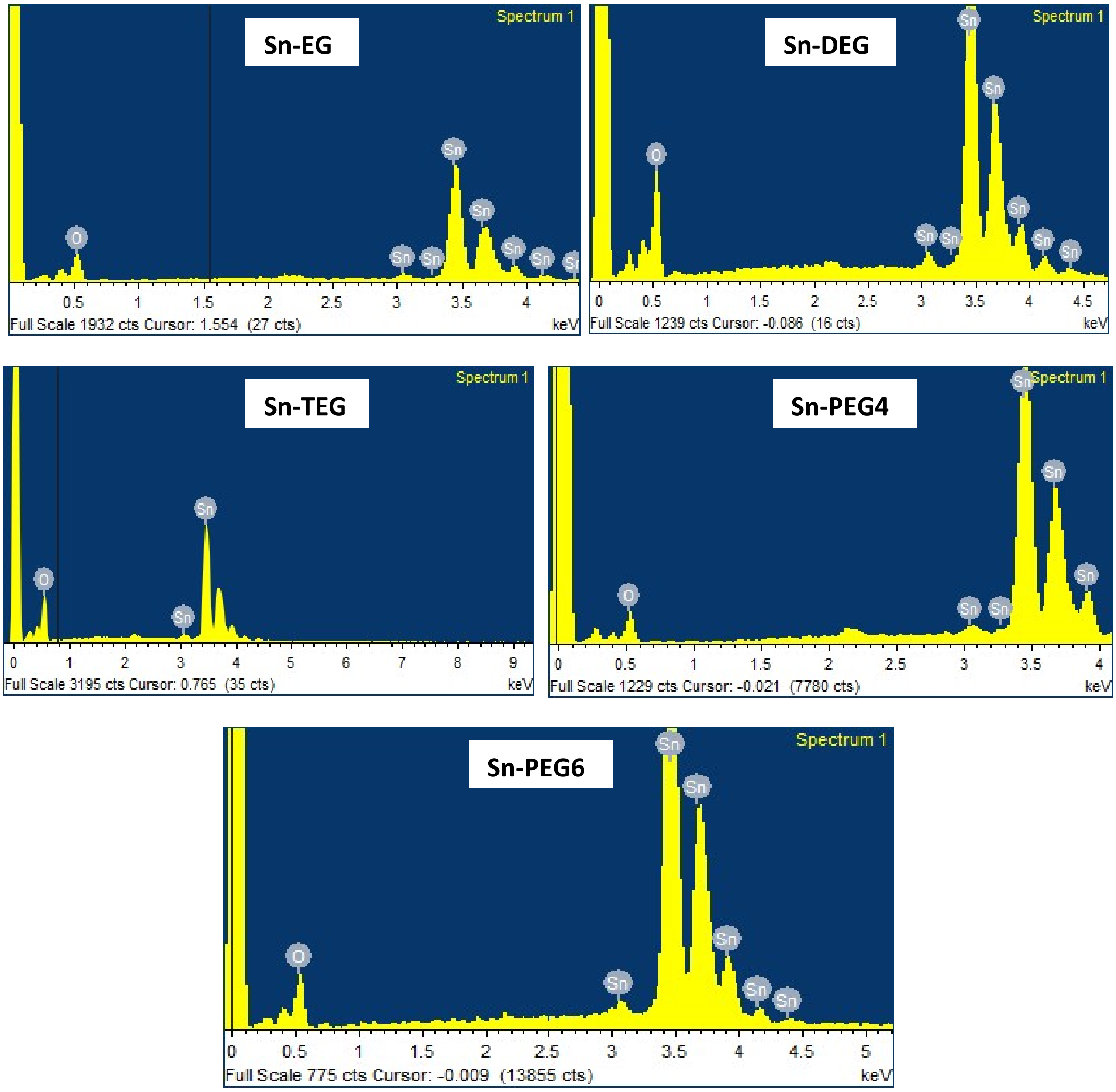

Fig. S4 EDX spectra of different polyol functionalised SnO_2 NPs.

Table S3 atomic % and weight % of oxygen and tin in prepared SnO_2 NPs.

Samples name	Weight %		Atomic %	
	Sn	**O**	**Sn**	**O**
Theoretical value	78.768	21.232		
Sn-EG	61.57	38.43	17.76	82.24
Sn-DEG	58.49	41.51	15.96	84.04
Sn-TEG	52.80	47.20	13.10	86.90
Sn-PEG4	75.38	24.62	29.22	70.78
Sn-PEG6	73.40	26.60	27.11	72.89

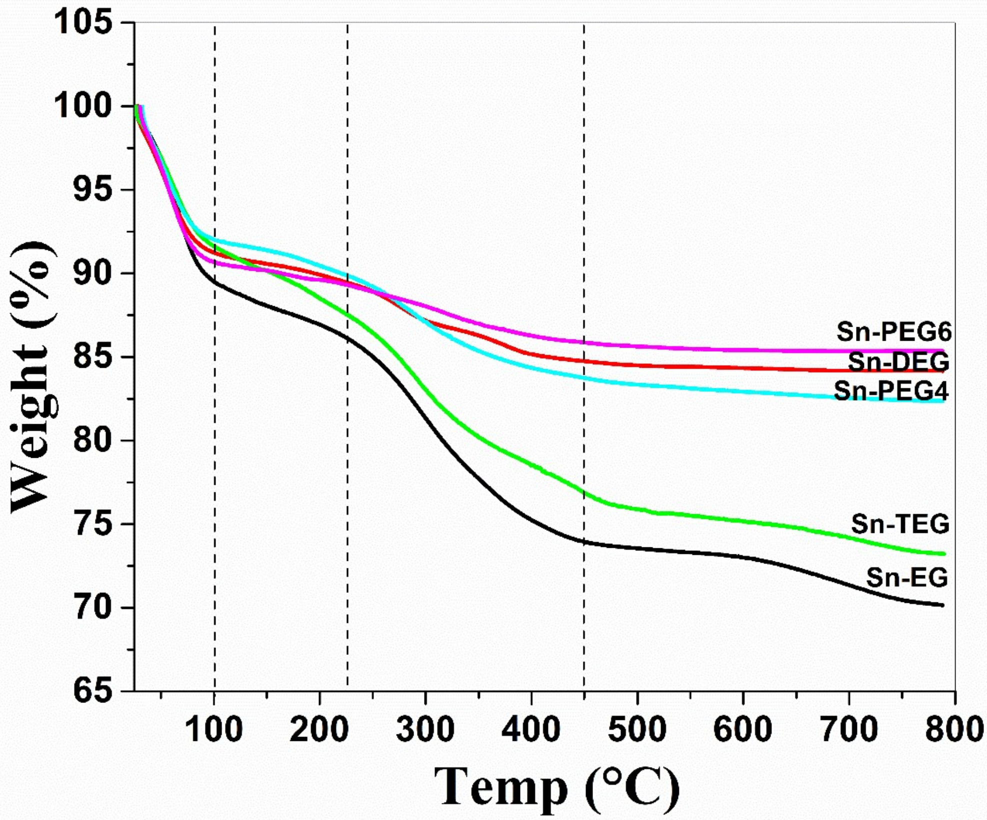

Fig. S5 Plot of weight loss profile of different SnO_2 NPs with respect to heating temperature.

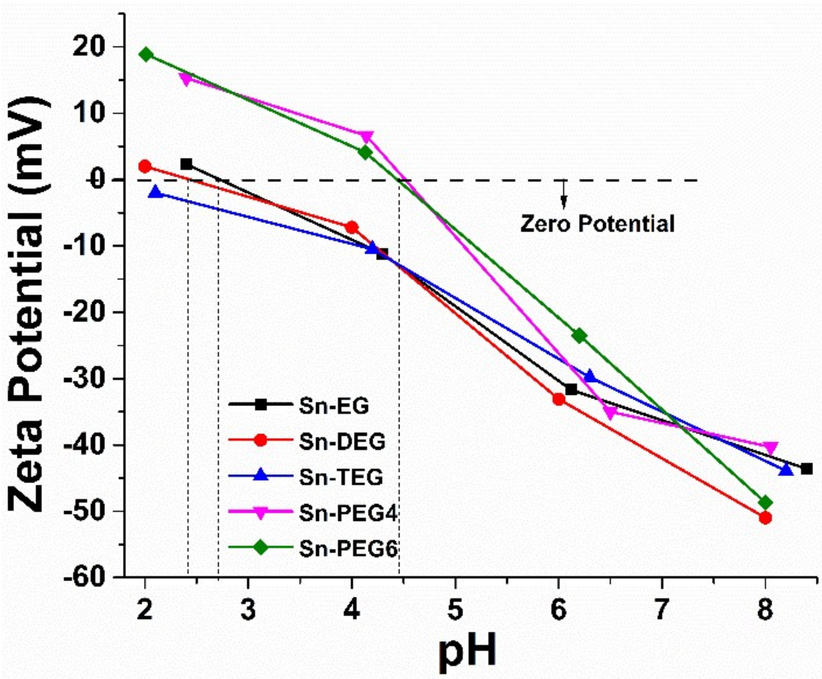

Fig. S6 Zeta potential of polyol functionalised SnO_2 NPs at different pH value of the dispersion.

Table S4 Surface area, pore size and pore volume of SnO_2 nanoparticles.

Sample Name	Surface area (m^2/g)	Pore size (nm)	Pore volume (cc/g)
Sn-EG	219.160	Diameter = 3.053 nm	0.012
Sn-DEG	110.160	Diameter = 4.042 nm	0.139
Sn-TEG	133.311	Diameter = 3.119 nm	0.174
Sn-PEG4	86.509	Diameter = 4.023 nm	0.152
Sn-PEG6	101.188	Diameter = 6.630 nm	0.197

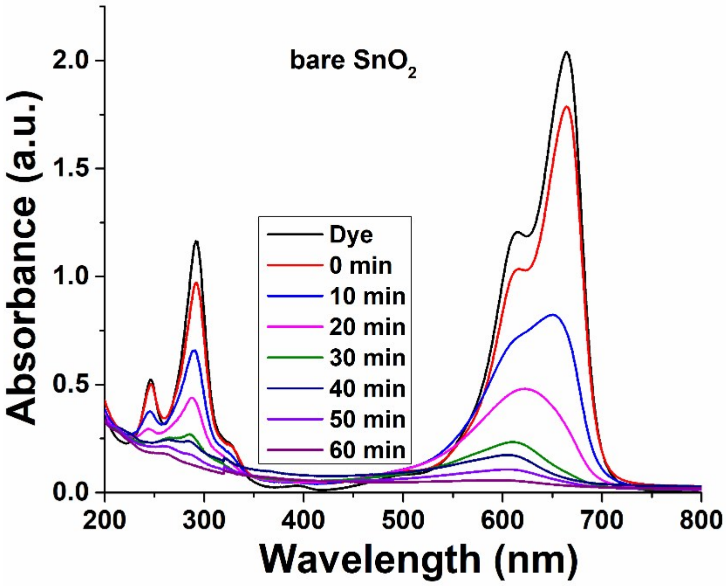

Fig. S7 UV-Vis absorption spectra of MB dye after different time of UV light (λ = 254 nm) irradiation in presence of bare SnO_2 catalyst.

Table S5 Dye degradation efficiency of bare SnO2 nanocatalyst towards MB dye after different time of UV light (λ = 254 nm) irradiation.

UV irradiation Time	Dye degradation Efficiency (Bare)
0 min	11.1 %
10 min	58.2 %
20 min	74.74 %
30 min	86.45 %
40 min	89.51 %
50 min	92.77 %
60 min	96.4 %

The linear relation for Langmuir isotherm is

$$\frac{C_e}{q} = \frac{1}{b\, q_m} + \frac{C_e}{q_m}$$

Where C_e is equilibrium concentration of dye, q is adsorption capacity, b is Langmuir adsorption constant and q_m is maximum monolayer adsorption capacity.

The different values of R_l define the several types of isothermic conditions such as linear (R_l = 1), favourable (0 < R_l < 1), unfavourable (R_l > 1) and irreversible (R_l = 0). The equation for R_l defined as

$$R_l = \frac{1}{b\, C_m}$$

Where C_m is the maximum concentration of dye used for isotherm study.

The other model is Fraundlich isotherm and expressed as

$$\log q = \log K + \frac{1}{n} \log\ C_e$$

Where K is the capacity and n is adsorption intensity of dye on catalyst surface.

Temkin relation is used for the study of adsorption energy and the adsorption process to decide whether it is endothermic or exothermic. The linear form of Temkin relation expressed as

$$q = \ \beta\ ln\alpha + \ \beta\ ln\ C_e$$

β value is calculated from equation

$$\beta = \frac{RT}{s}$$

Where α is equilibrium constant, T is temperature, R is universal gas constant and s is temkin constant corresponds to heat sorption (J mg^{-1}).

Dubinin model is used for the estimation of free energy and calculated by its linear equation

$$\ln q = \ln Q_m - B\,\varepsilon^2$$

$$\varepsilon = RT\ln\ (1 + \frac{1}{C_e})$$

Where B = adsorption energy constant, Q_m is theoretical saturation capacity.

The mean free energy calculated by

$$E = \frac{1}{\sqrt{2B}}$$

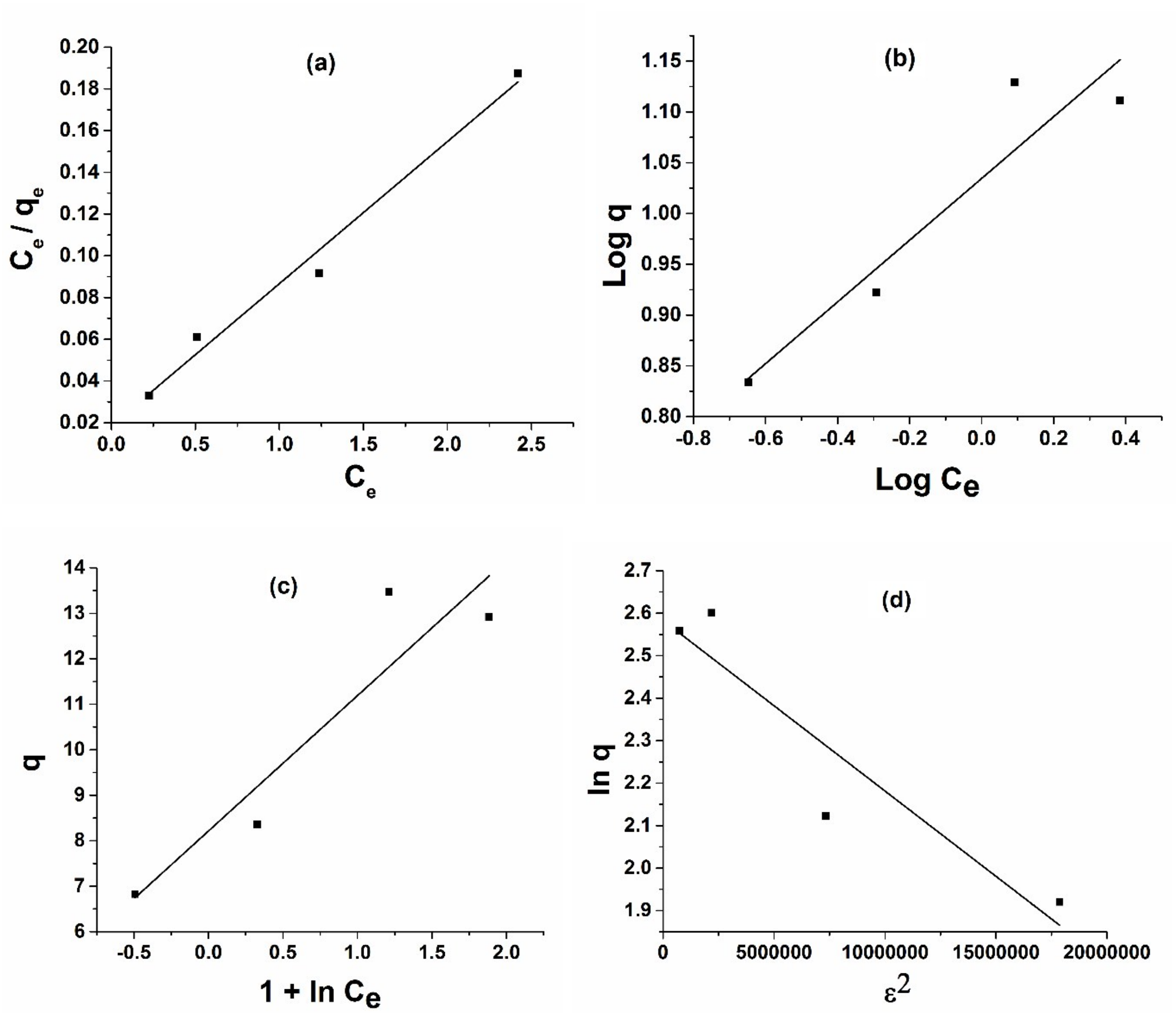

Fig. S8 Isotherm plots for adsorption of MB on SnO_2 surface; (a) Langmuir isotherm, (b) Freundlich isotherm, (c) Temkin isotherm, (d) Dubinin isotherm.

Table S6 Adsorption isotherms parameters of MB dye on SnO_2 NPs.

Model	Parameters	Values
Langmuir	q_m (mg/g)	14.689
	b (L/mg)	3.672
	R_l	0.0358
	R^2	0.9782
Freundlich	K $[(mg/g)(1/mg)^{(1/n)}]$	10.825
	n	3.290
	R^2	0.8416
Temkin	α (L/g)	15.785
	β	2.976
	s	838.054
	R^2	0.8068
Dubinin	B	4.01 E-08
	Q_m	13.236
	E (J/mole)	3529.033
	R^2	0.81257

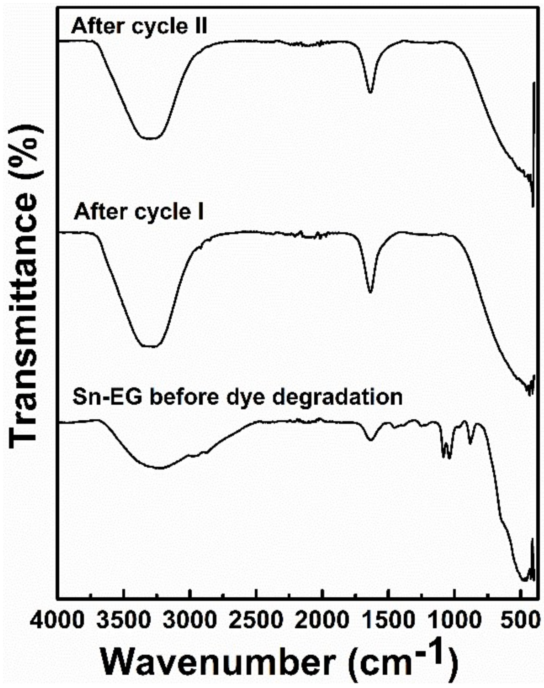

Fig. S9 FTIR spectra of Sn-EG NPs before and after dye degradation experiment.

Heber Photoreactor

The multi-lamp photoreactor consists of 16 mercury lamps (8 watt each) arranged in a circular manner. The 16 lamps are divided into two sets with each set having 8 lamps emitting a fixed wavelength of either 254 nm or 365nm. The power density of 365 nm and 254 nm with eight UV lamps are 2650 μW/cm^2 and 1592 μW/cm^2 respectively. The lamp to sample distance is 35 – 40 mm. A schematic of the reaction chamber is given below.

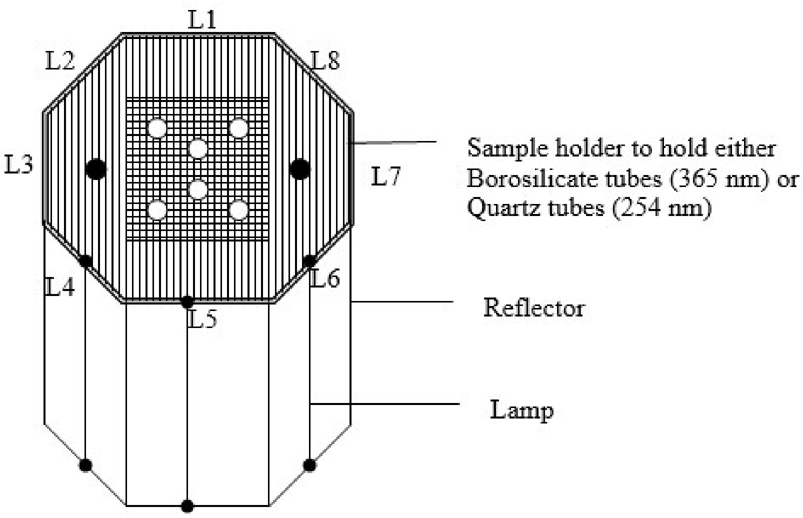

Fig. S10 Schematic of the photocatalytic reaction chamber.