Electronic Supplementary Material (ESI) for RSC Advances.

Regeneration of Efficient, Solar Active Hierarchial ZnO Flower Photocatalyst for Repeatable Usage: Desorption of Poisoned Species from Active Catalytic sites

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Supportive Information

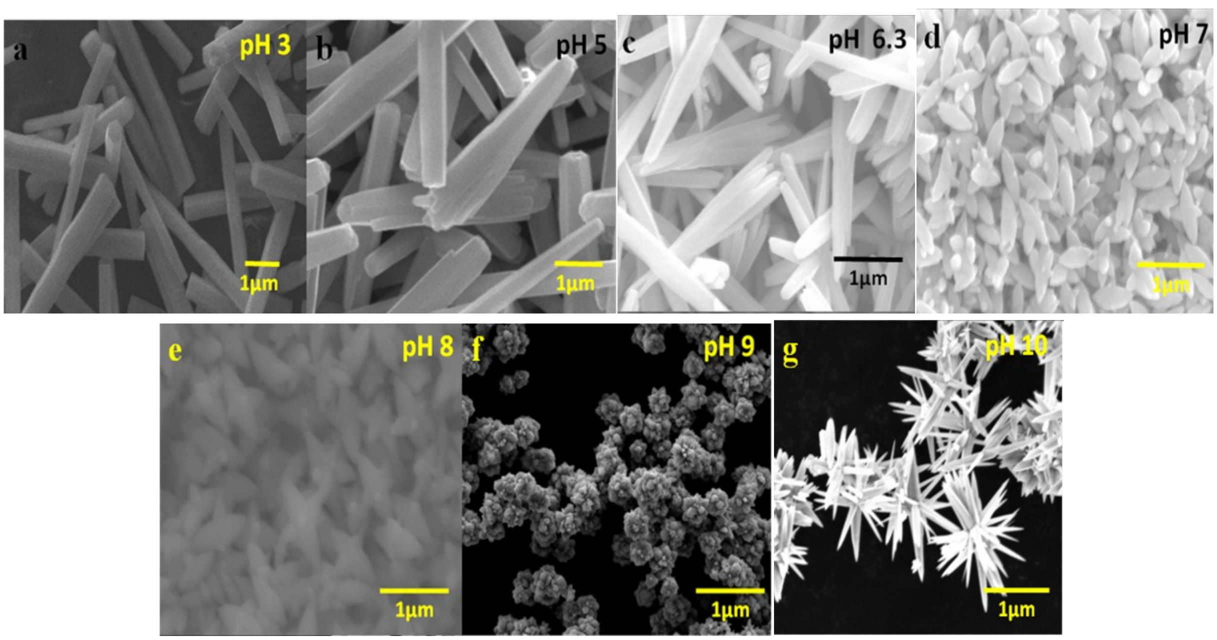


Figure S1. SEM images for different morphology of ZnO nanostructures (a) rods, (b) bubs, (c) brooms, (d) spindles, (e) stars, (f) flowers and (g) muiltpods respectively.

ZnO nanostructures with different morphologies (rods, broom, buds, stars, hierarchial flowers, multipods) were grown by varying the pH (3 to 10) of the growth solution. Nanostructures were characterised for their structural, microstructural, optical, surface area, photocatalytic and reactive oxidation species (ROS) production properties and results are published [K.S. Ranjith and R. T. Rajendra kumar, Journal of Photochemistry & Photobiology, A: Chemistry, 329 (2016) 35-45]. Among the various ZnO morphologies, hierarchial ZnO flowers show best photocatalytic activity and therefore chosen for reusable studies presented in this work.

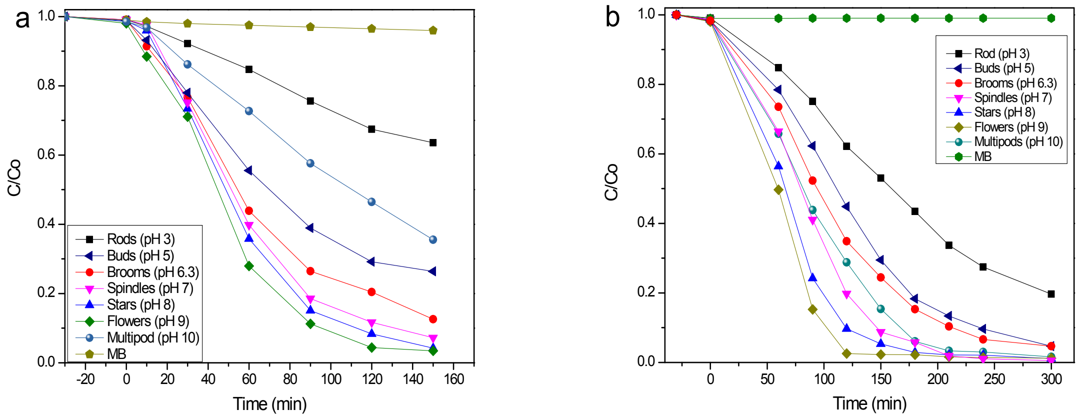


Figure S2. Photo degradation efficiency of the different morphology of ZnO nanostructures against MB under UV irradiation and sunlight irradiation.

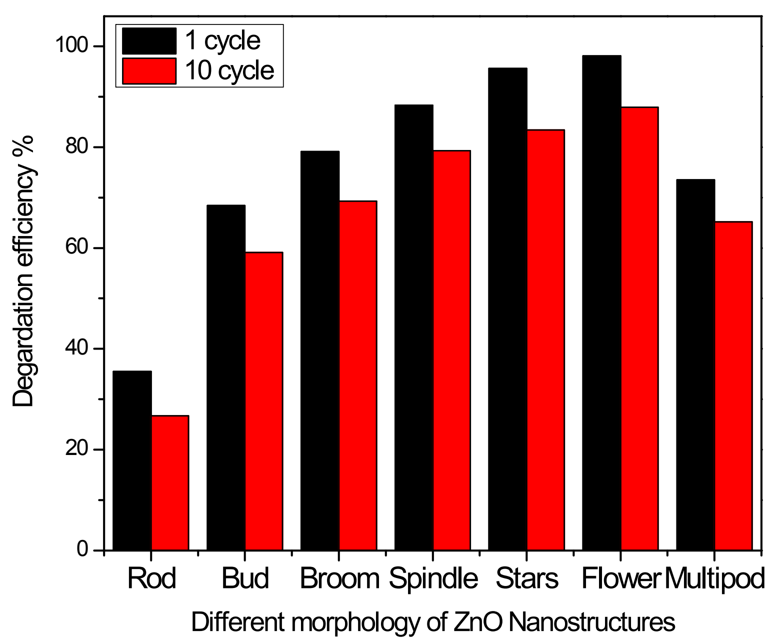


Figure S3. (a) Recyclic degradation activity for different morphology of ZnO nanostructures under 1st and 10th recycles under 150 mins of UV irradiation.

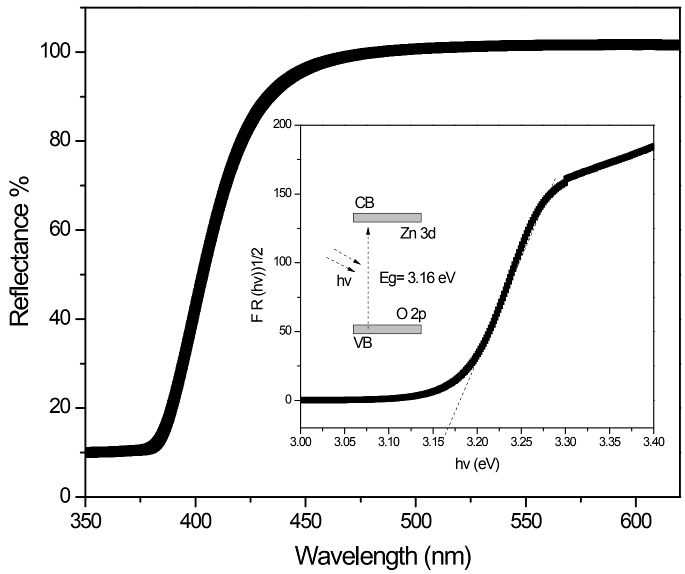
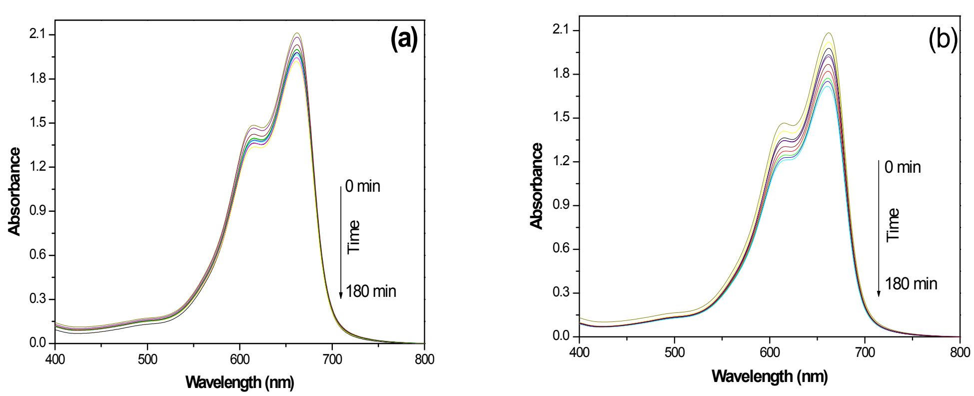


Figure S4. Diffused reflectance spectra (DRS) of hierarchial ZnO flowers. Inset shows K-M polt for band gap calculation.



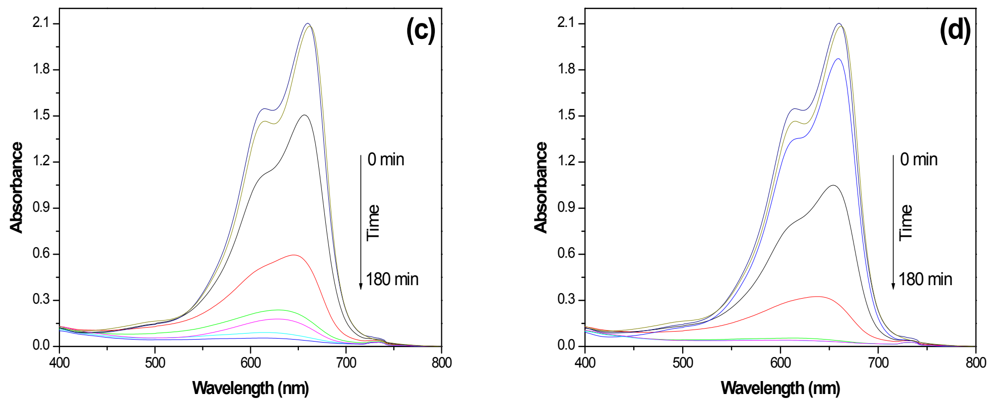


Figure S5. Photocatalytic performance of hierarchial ZnO flowers catalyst : (a) without catalyst in UV, (b) with catalyst under dark; (c) UV; (d) sunlight irradiation.

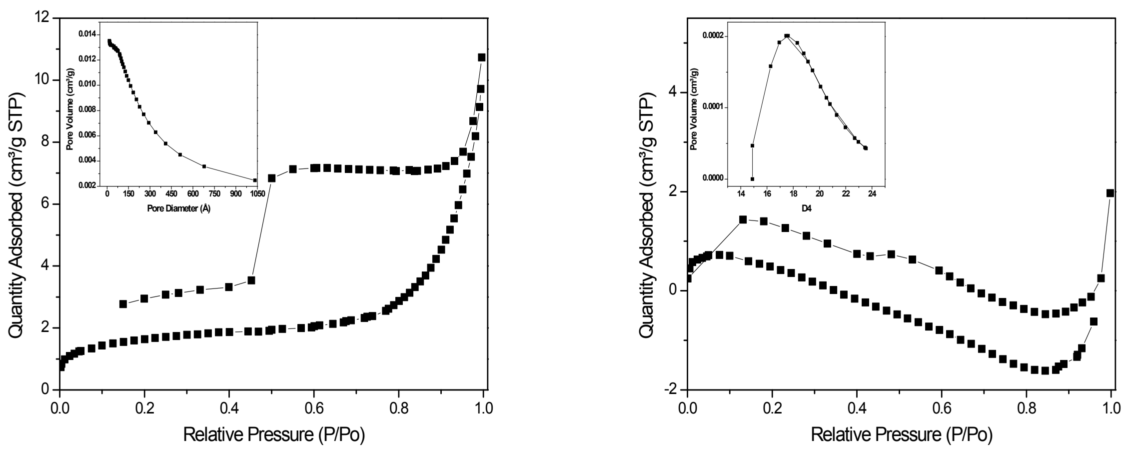


Figure S6. N_2 adsorption–desorption isotherm of Hierarchial and Commercial ZnO structures and the insert shows their respective pore size distribution.

The pore structure and the surface area analysis of ZnO nanoflower like structure were investigated by nitrogen adsorption–desorption isotherms and the pore size distribution was calculated by BJH method according to the desorption branch. The N_2 adsorption–desorption isotherms of the as synthesized ZnO exhibited a hysteresis loop. A sharp increase in the adsorption volume of N_2 was observed and located in the P/P_0 range of 0.8–0.99. This sharp increase can be attributed to the capillary condensation, indicating the good homogeneity of the sample and macro pore size for the P/P_0 position of the inflection point is related to the pore size. [ ] Average pore radius of ZnO, shown by pore size distribution curve (inset of figure. 5) is 11.62 nm (116 °A). The pore size distribution of the ZnO sample thus confirms the macroporous structure. Surface area measurements, made by the BET method, provide the specific surface area ZnO as 5.71 m^2/g. The single point adsorption total pore volume of pores less than 4990.155 °A diameter at $P/P_0 = 0.9961$ is 0.0166 cm^3/g.

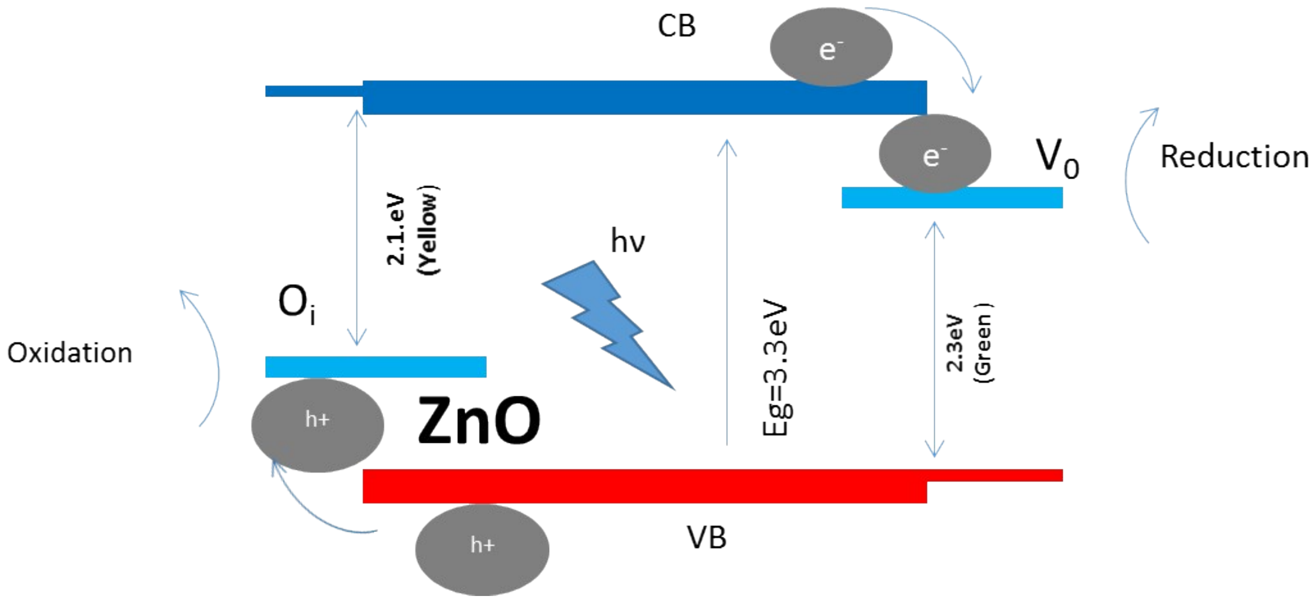


Figure S7. Band diagram of the defect rich ZnO nanostructures

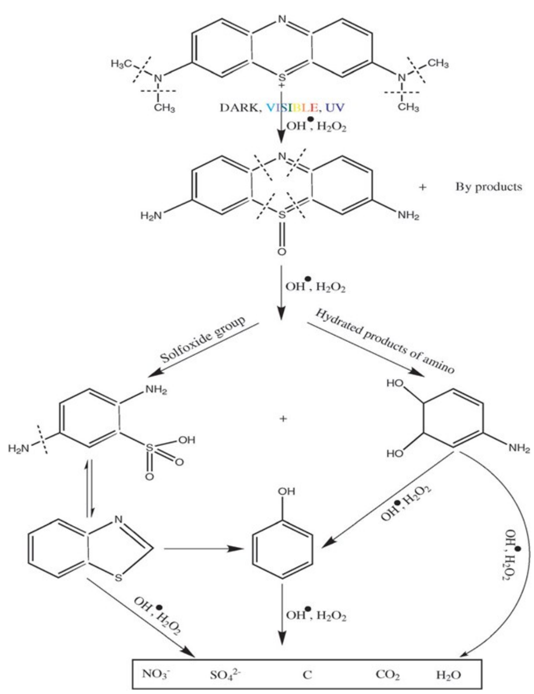


Figure S8. Proposed MB degradation pathway during the photocatalytic process [**1**]

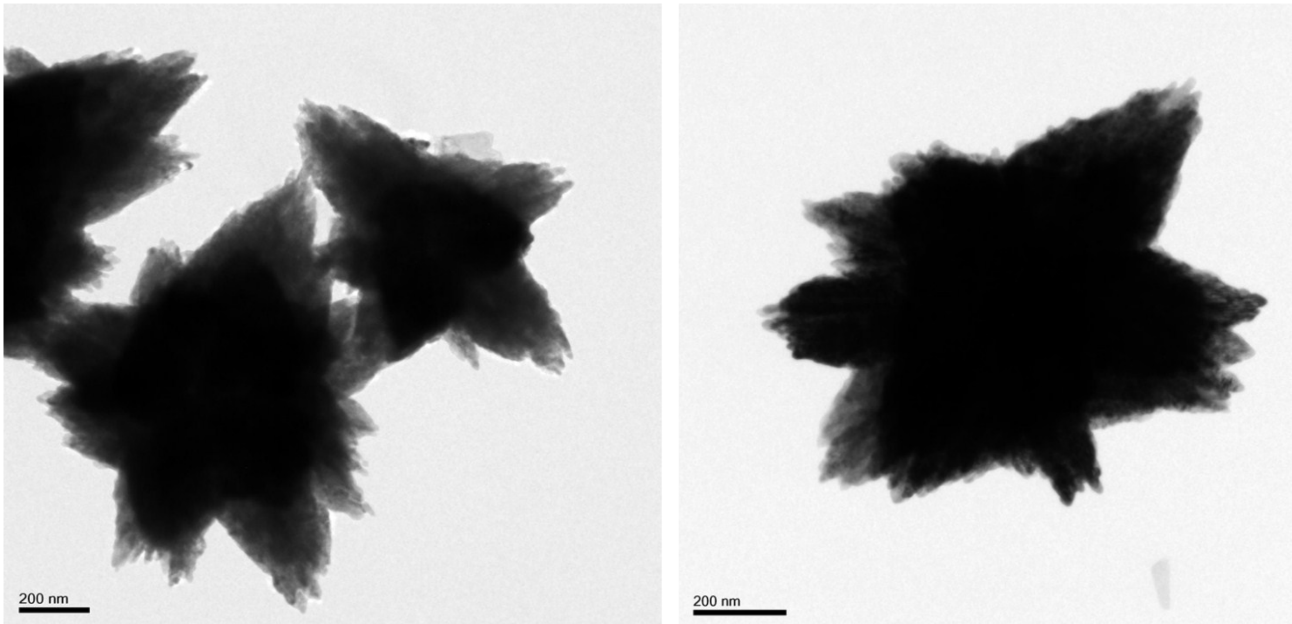


Figure S9. TEM micrographs of the Hierarchial ZnO flower catalyts after mild acid treatment.

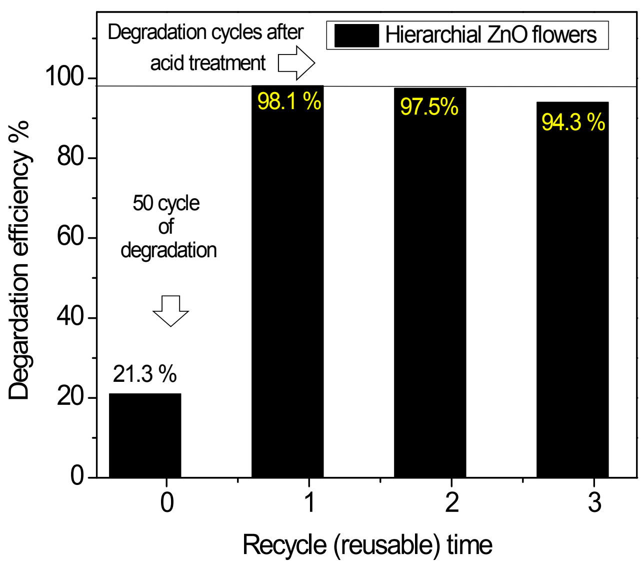


Figure S10. Recyclic catalytic performance on acid treated hierarchial ZnO flowers

Reference

1 A. Chithambararaj, N. S. Sanjini, A. Chandra Bose. S. Velmathi, *Catal. Sci. Technol,* 2013*,* **3**, 1405-1414.