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Supporting information

Functionalized Nitrogen-doped Carbon Dots Modification of Yolk-Shell $ZnFe_2O_4$ Nanospheres with Highly Efficient Light Harvesting and Superior Catalytic Activity

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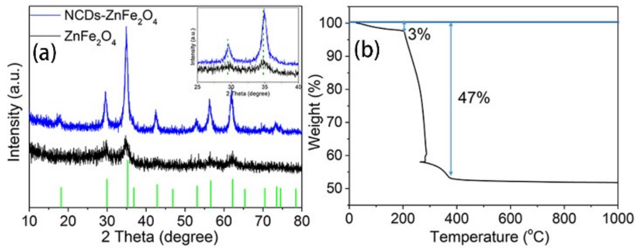

Fig. S1 (a) XRD patterns of $ZnFe_2O_4$ and CN-$ZnFe_2O_4$. Inset: high-resolution spectrum in range of 2θ from 25 to 40 °. (b) TGA profile of Zn-Fe glycerinate under air flow.

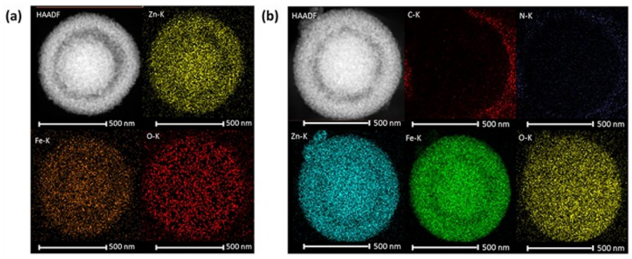

Fig. S2 HAADF-STEM image and element mapping images of $ZnFe_2O_4$ yolk-shell (a) and NCDs-$ZnFe_2O_4$ yolk-shell photocatalysts (b).

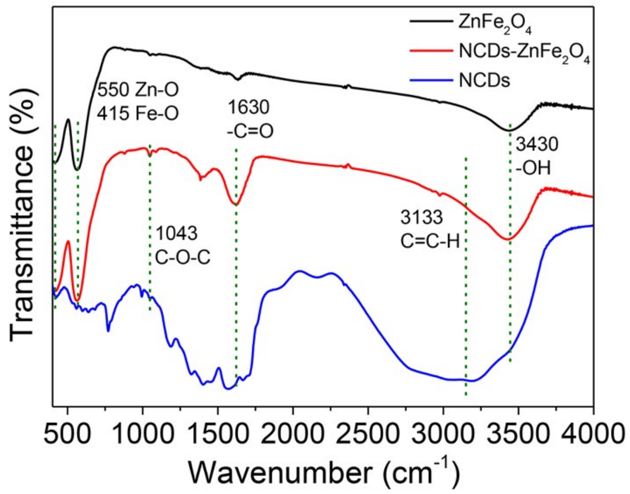

Fig. S3 FTIR spectra of NCDs, $ZnFe_2O_4$ and NCDs-$ZnFe_2O_4$.

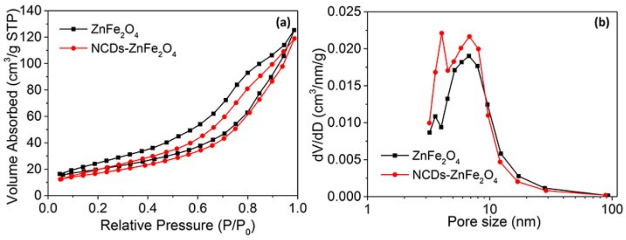

Fig. S4 N_2 adsorption-desorption isotherms (a) and pore-size distribution (b) of $ZnFe_2O_4$ yolk-shell and NCDs-$ZnFe_2O_4$ yolk-shell structure.

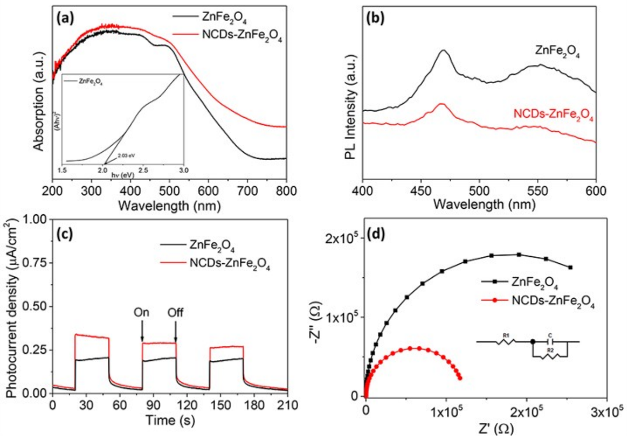

Fig. S5 (a) UV–vis diffuse reflectance spectra (inset: estimated band gap of pure $ZnFe_2O_4$) (b) photoluminescence emission spectra (excitation wavelength: 325 nm) (c) Photocurrent response under visible light and (d) EIS Nyquist plot of NCDs-$ZnFe_2O_4$ and $ZnFe_2O_4$.

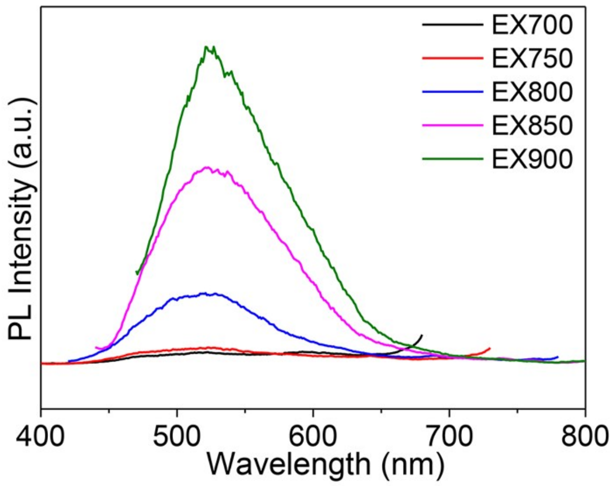

Fig. S6 Up-conversion PL properties of the prepared NCDs at different excitation wavelength length.

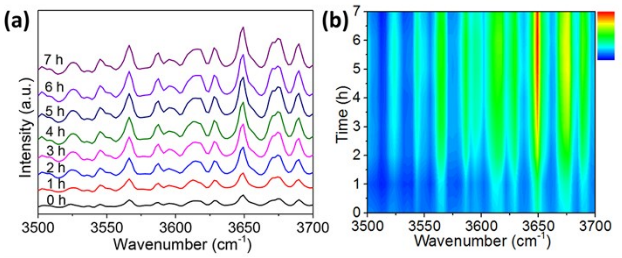

Fig. S7 *In situ* FTIR spectra of gaseous *o*-DCB during photocatalytic process (a) and corresponding time-domain IR spectra (b) in the wavenumber region of 3500-3700 cm^{-1}.

Table S1 Resistance and capacitance according to the simulated circuit.

Sample	R1 (Ω)	R2 (10^5 Ω)	C (10^-5 F)
$ZnFe_2O_4$	81.0	3.6	2.4
NCDs-$ZnFe_2O_4$	50.4	1.2	2.2

Table S2 Comparison with different photocatalysts reported in literatures for *o*-DCB degradation.

Materials	Conditions	Degradation efficiency	Reference
TiO_2	UV light & Ozone	77% in 3.5 h	1
Porous photonic TiO_2	UV light	50% in 6 h	2
SnO_2	Visible light	45% in 4 h	3
$TiO_2/SnO_2/WO_3$	Visible light	94.5% in 6 h	4
Flower-like $BiPO_4$/BiOBr	Visible light	53.6% in 8 h	5
$ZnFe_2O_4/In_2O_3$	Visible light	68.7% in 8 h	6
V_2O_5 hollow sphere	Visible light	45% in 7 h	7
β-$Bi_2O_3/BiVO_4$ nanocomposite	Visible light	70% in 6 h	8
NCDs-$ZnFe_2O_4$ yolk-shell nanospheres	Visible light	74% in 7 h	This work

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