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Electronic supplementary information (ESI) available

Carbon Quantum Dots Embedded with Mesoporous Hematite Nanospheres as Efficient Visible Light-active Photocatalysts

*Byong Yong Yu and Seung-Yeop Kwak**

Department of Materials Science and Engineering, Seoul National University,
599 Gwanak-ro, Gwanak-gu, Seoul, Korea

* To whom correspondence should be addressed. *E-mail:* sykwak@snu.ac.kr.

Tel: +82-2-880-8365, *Fax:* +82-2-885-1748

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Table S1. FWHM values of the main diffraction peaks and the crystallite size for mesoporous hematite with the respective diffraction planes.

h k l	2θ (deg.)	*d*-spacing (nm)	Intensity (a.u.)	FWHM (2θ)	Crystallite size (nm)
0 1 2	24.10	0.36	28.1	0.34	23.63
1 0 4	33.10	0.27	100.0	0.36	22.77
1 1 0	35.56	0.25	70.7	0.36	22.92
1 1 3	40.80	0.22	23.2	0.36	23.29
0 2 4	49.42	0.18	34.1	0.38	22.76
1 1 6	54.02	0.17	45.1	0.38	23.21
2 1 4	62.40	0.15	28.4	0.38	24.17
3 0 0	63.98	0.14	25.4	0.38	24.38

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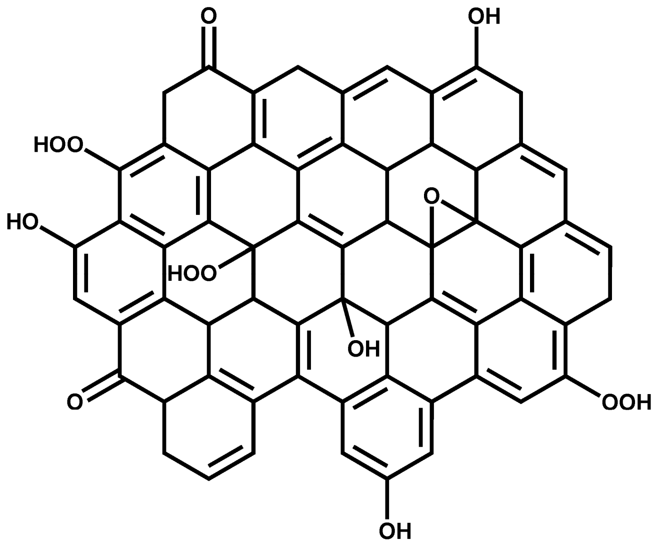

Fig. S1 Chemical structure of CQD.

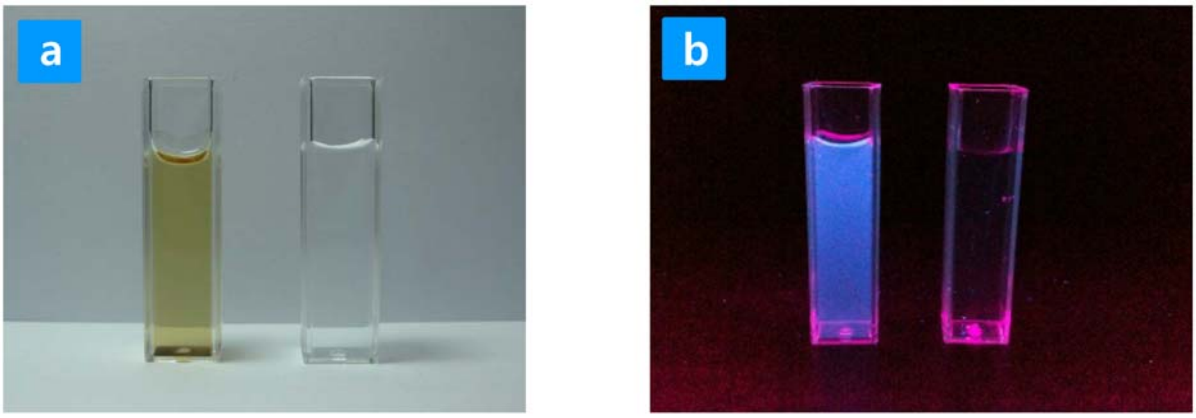

Fig. S2 CQDs optical image in water illuminated under (a) white (left; CQDs in water, right; water) and (b) UV light (left; CQDs in water, right; water).

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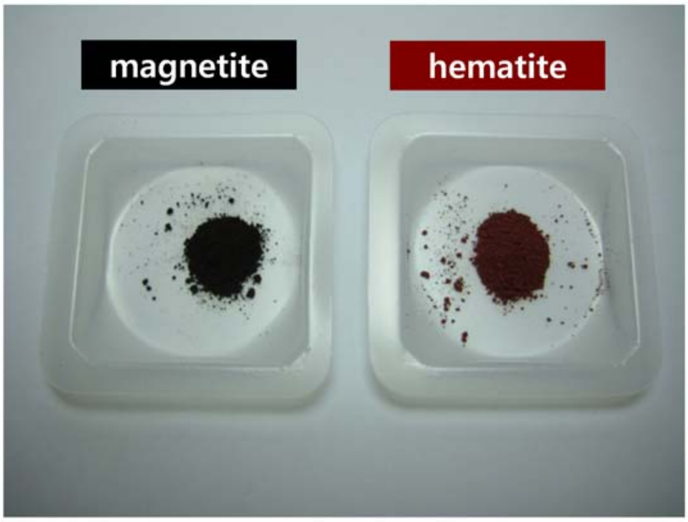

Fig. S3 Photograph of mesoporous magnetite and hematite powders.

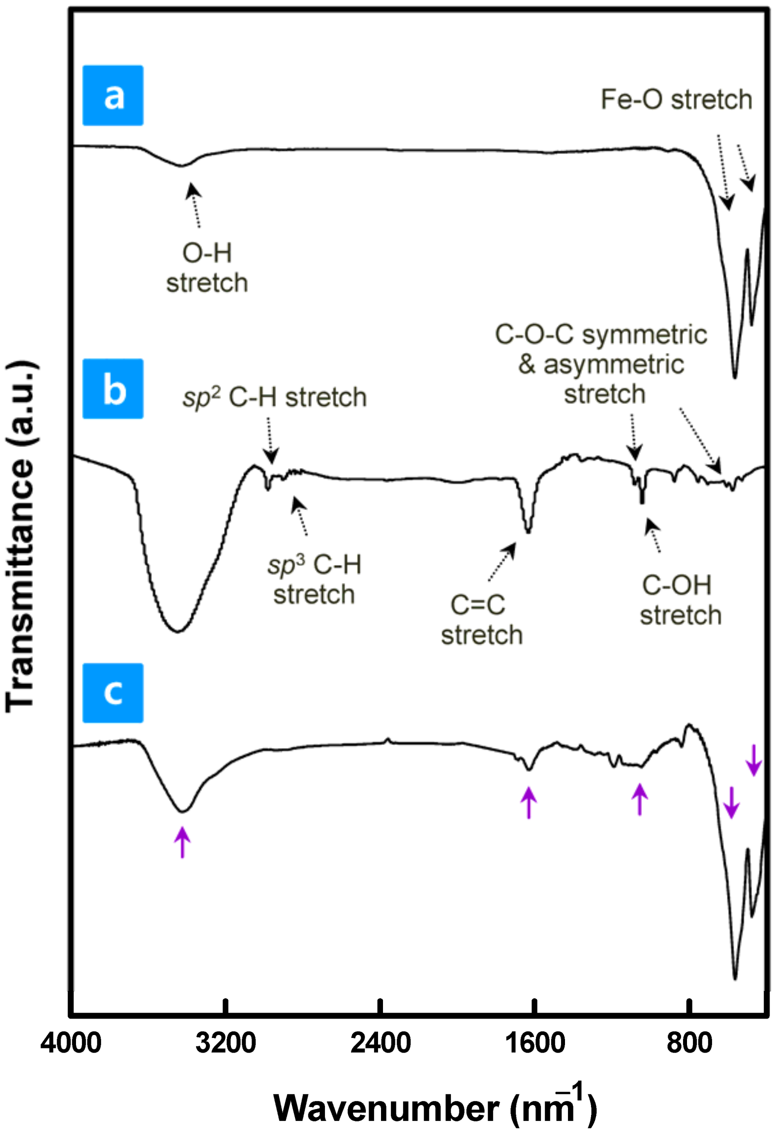

Fig. S4 FT-IR spectrum of (a) MH, (b) CQD, and (C) CQD/MH.

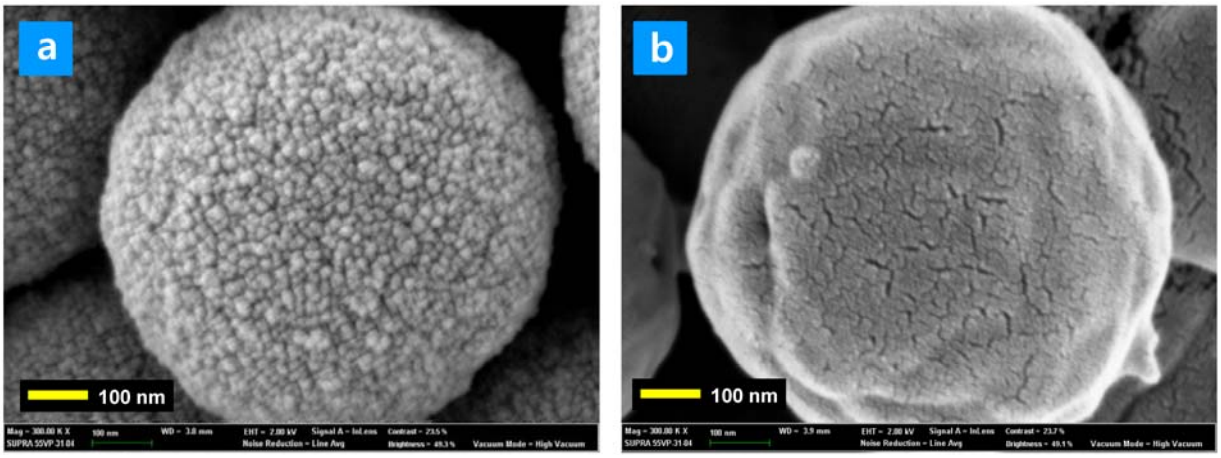

Fig. S5 FE-SEM images of (a) MH, and (b) CQD/MH (a more detailed view).

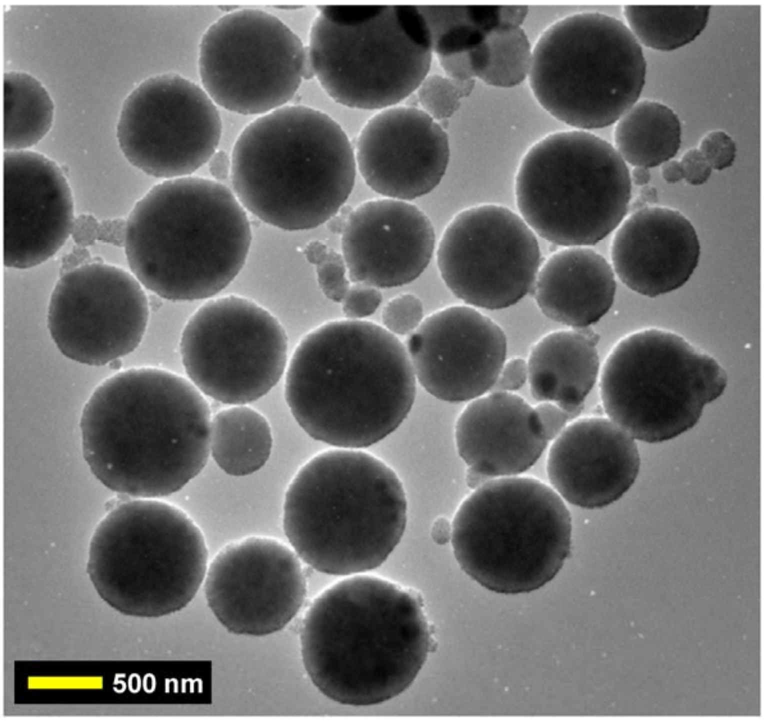

Fig. S6 TEM images of CQD/MH hybrid clusters.

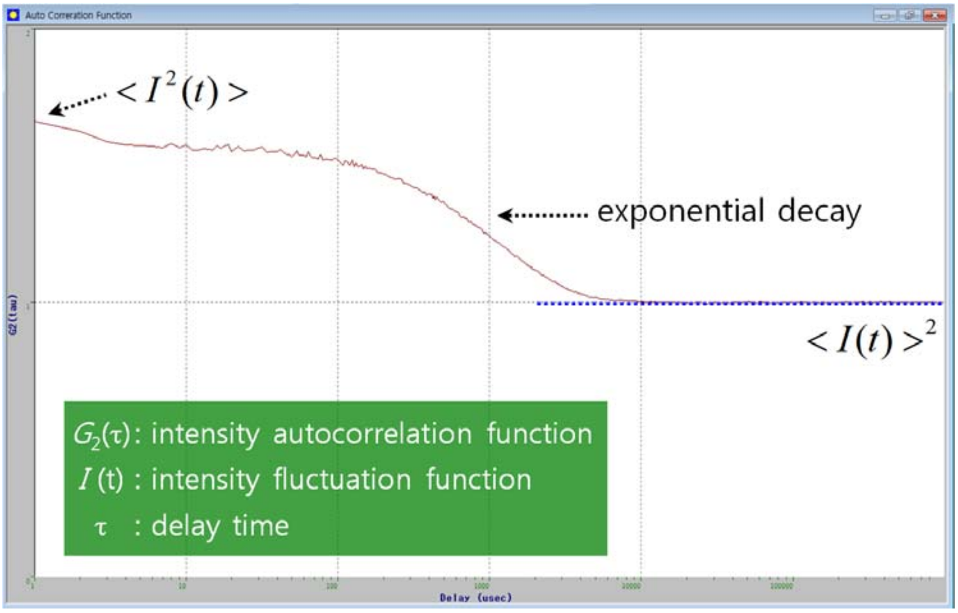

Fig. S7 The intensity auto-correlation function (ACF), $G_2(\tau)$ for CQD/MH sample in DLS.

The second-order correlation function $G_2(\tau)$ can be expressed as a function of the first-order correlation function $G_1(\tau)$ according to the Siegert relation: $G_2(\tau) = B\left(1+\beta G_1(\tau)^2\right)$, where B is the baseline constant and β is a coherence constant. In the case of a perfect setup, both equal unity. In the case of single-exponential decay, $G_1(\tau)$ can be expressed in terms of a typical decay rate Γ and time t; $G_1(\tau) = \exp(-\Gamma\tau)$. The apparent translational diffusion coefficient, D, is given by equation: $\Gamma = Dq^2$, where q is the magnitude of the scattering vector $q = 4\pi n \sin(\theta/2)/\lambda$, where n is the refractive index of the solvent, θ is the scattering angle, and λ is the wavelength of the incident light. For spherical particles, the translational diffusion coefficient can be related to the hydrodynamic radius, R, according to the Stokes-Einstein equation: $D = k_B T / 6\pi\eta R$, where D is the diffusion coefficient of the Brownian motion of spherical particles, k_B is the Boltzmann constant, T is the absolute temperature, and η is the viscosity of the solvent. The hydrodynamic radius distribution of

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particles, *G*(R) was estimated using the COTIN algorithm, which is conventionally used to determine the inverse Laplace transform of the measured amplitude autocorrelation function.[1, 2]

(1) R. Finsy, *Adv. Colloid Interfac.* 1994, **52**, 79.

(2) I. K. Voets, A. De Keizer, M. A. Cohen Stuart and P. De Waard, *Macromolecules* 2006, **39**, 5952.

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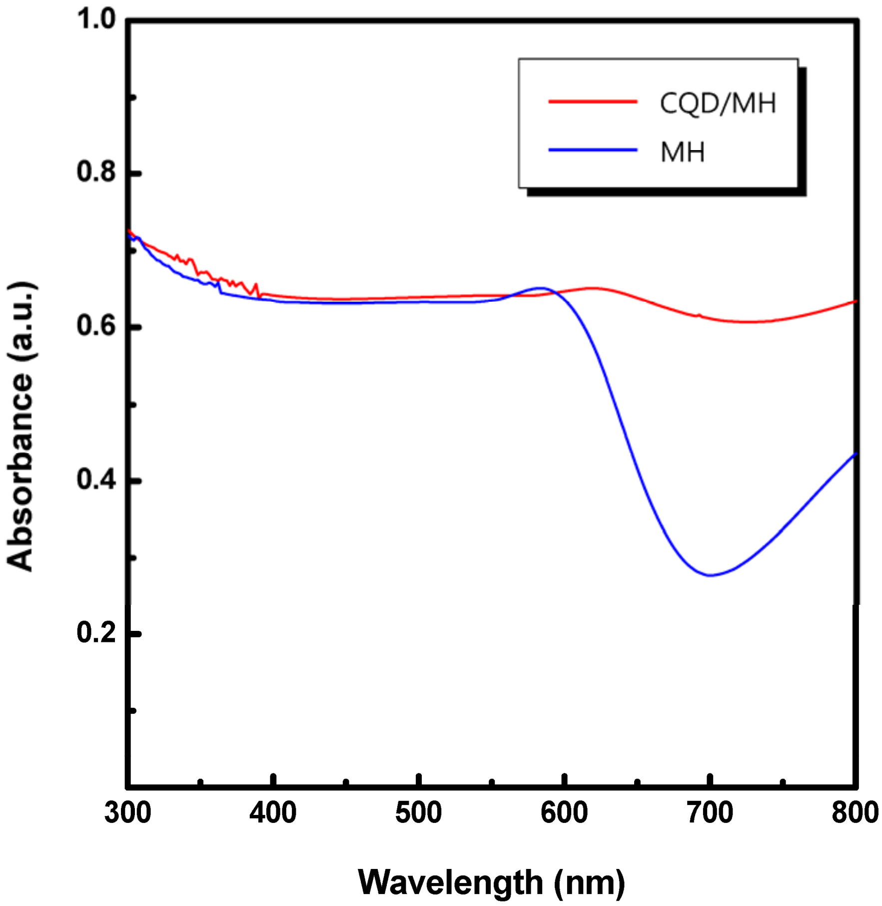
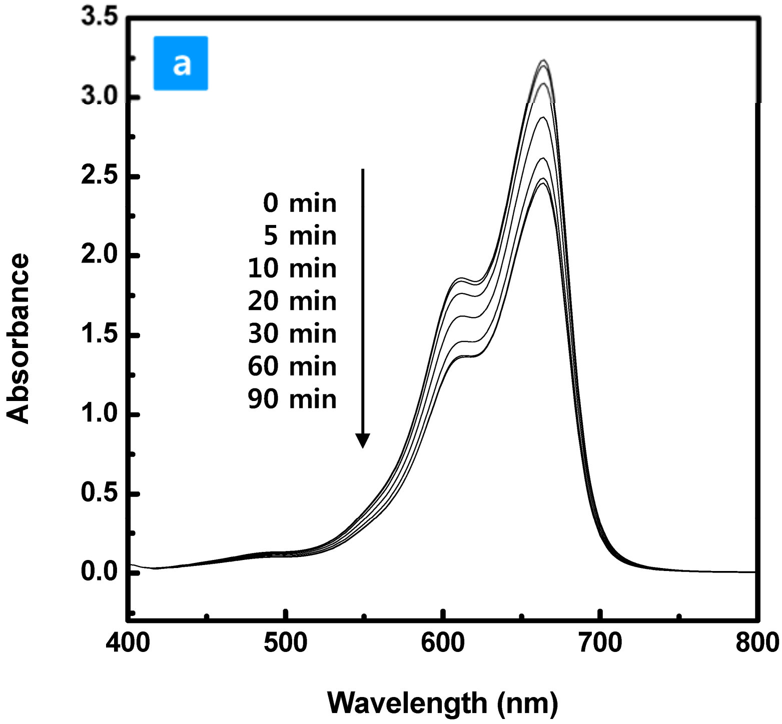


Fig. S8 UV-visible spectra of the MH and CQD/MH.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3.0
2.5
2.0
1.5
1.0
0.5
0.0
Absorbance
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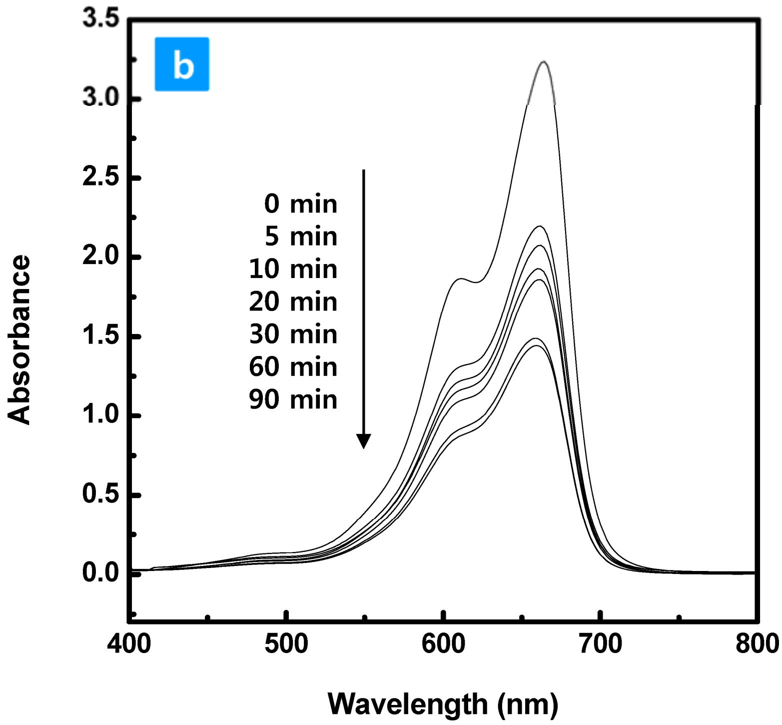
5 min
10 min
20 min
30 min
60 min
90 min
400
500
600
700
800
Wavelength (nm)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90 min
400
500
600
700
800
Wavelength (nm)

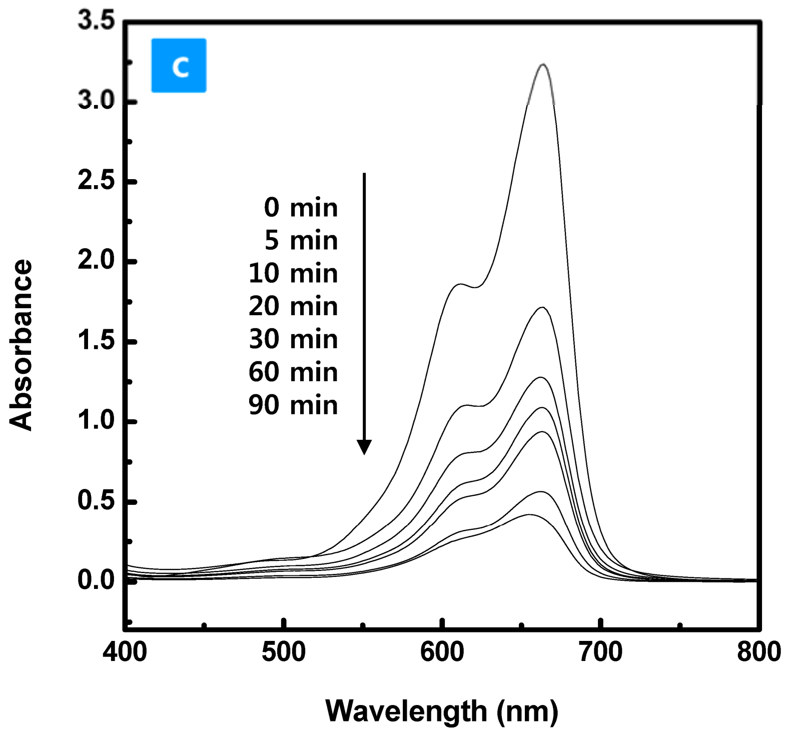

Fig. S9 Absorption spectra of MB solution taken at different photocatalytic degradation times using (a) MH, (b) MH+H_2O_2 and (c) CQD/MH.

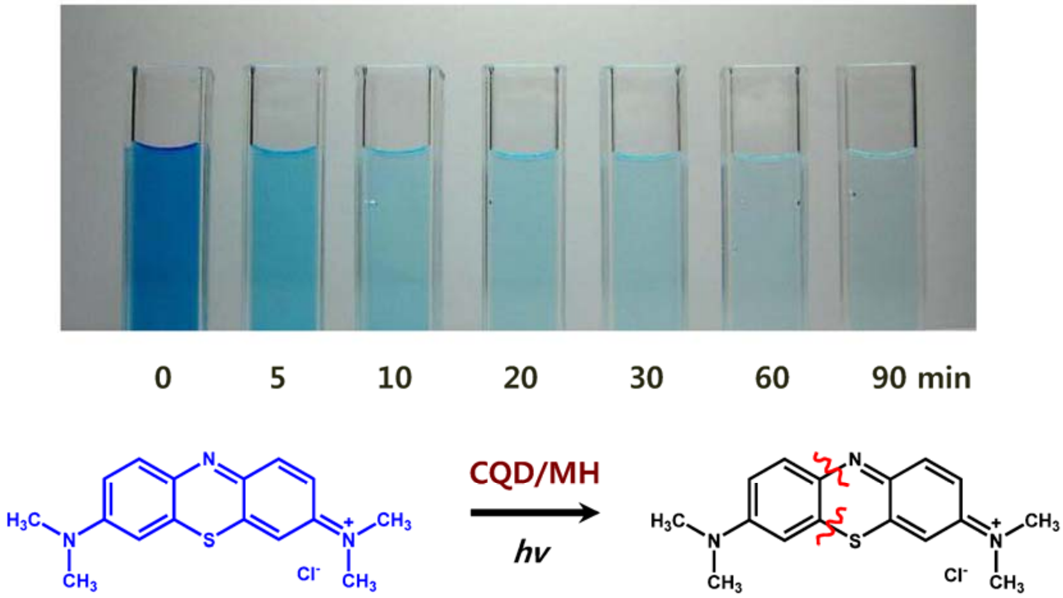

Fig. S10 Decolorization profiles of MB aqueous solution with visible light irradiation in the presence of the CQD/MH+H_2O_2.

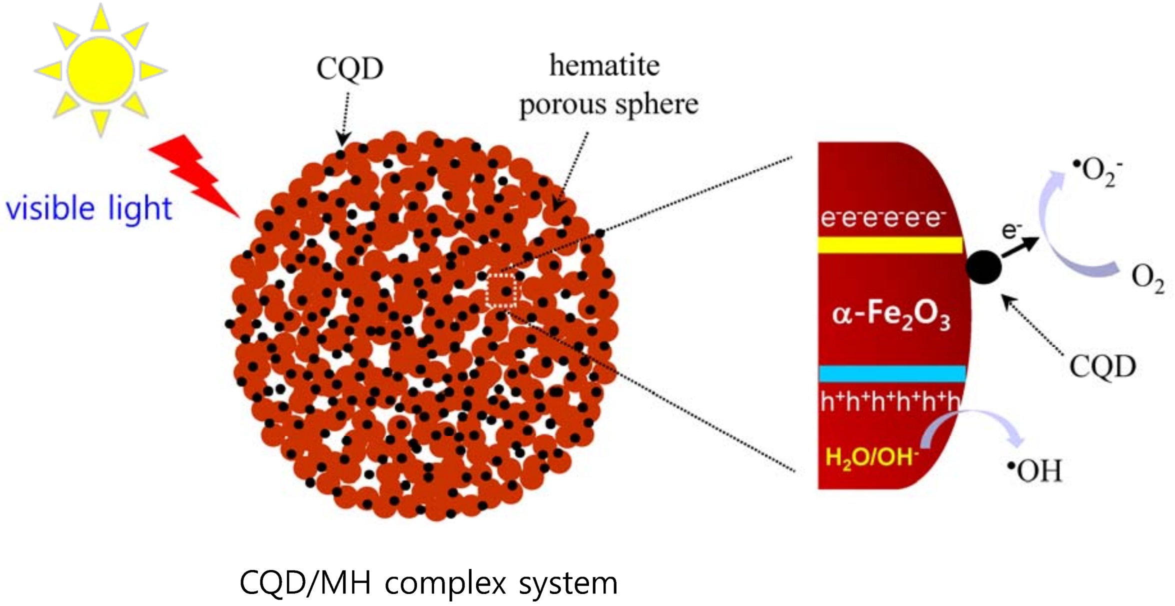

Fig. S11 Schematic illustration of possible catalytic mechanism for CQD/MH under visible light.